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Rev. 07/10/02

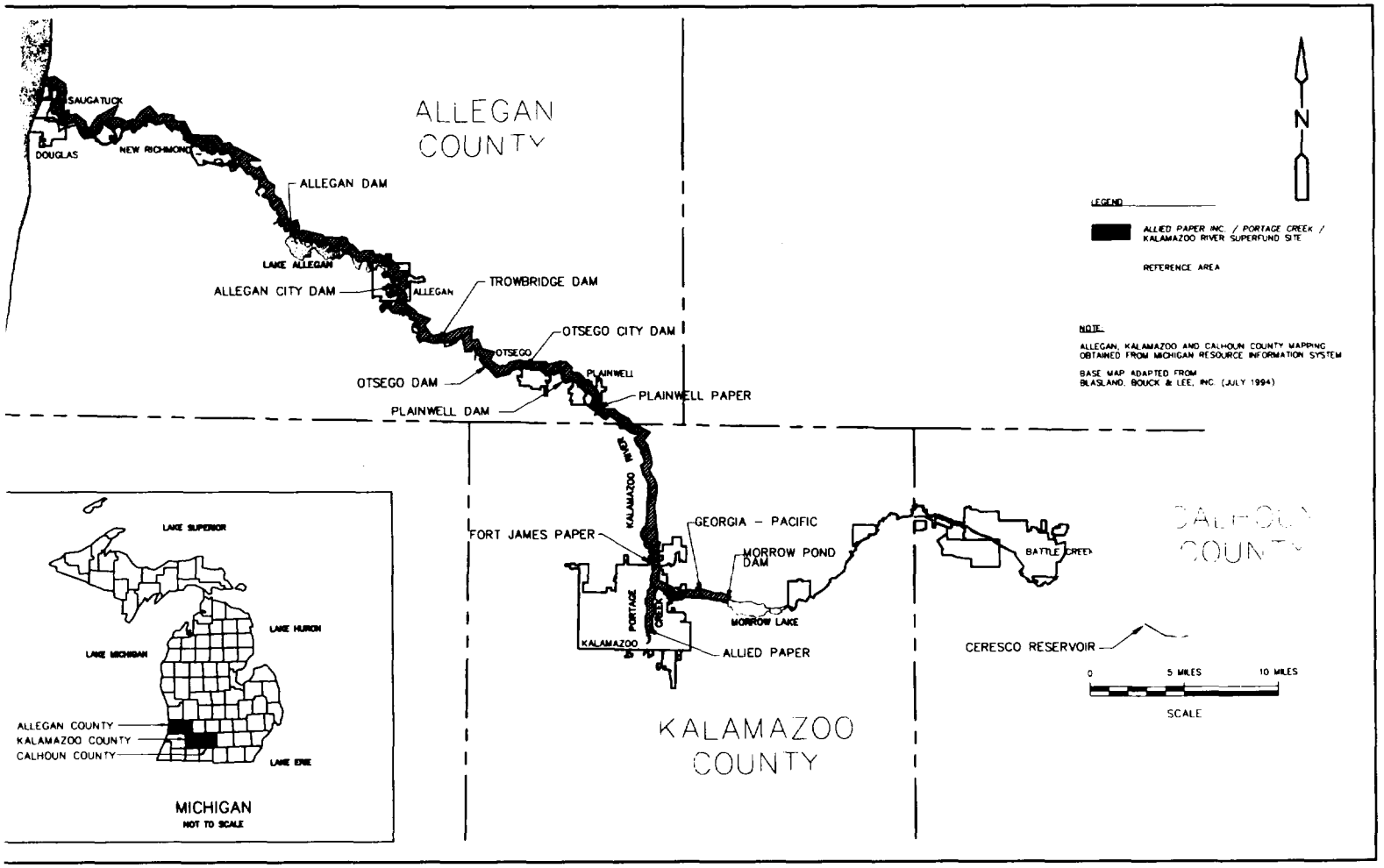
CDM Camp Dresser & McKee

167610 K3

Final
Human Health Risk Assessment
Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site

Michigan Department of Environmental Quality Environmental Response Division

August 18, 2000



Report

STATE OF MICHIGAN

JOHN ENGLER, *Governor*

DEPARTMENT OF ENVIRONMENTAL QUALITY

HOLLISTER BUILDING, PO BOX 30473, LANSING MI 48909-7973

INTERNET: http://www.deq.state.mi.us

RUSSELL J. HARDING, Director

REPLY TO:

ENVIRONMENTAL RESPONSE DIVISION
KNAPPS CENTRE
PO BOX 30426
LANSING MI 48909-7926

September 15, 2000

Saugatuck-Douglas Library
Reference Desk
10 Mixer St.
Douglas, Michigan 49406

Reference Desk: Human Health Risk Assessment

Please find enclosed a copy of the August 18, 2000 Human Health Risk Assessment. This report presents the results and findings of the Human Health Risk Assessment performed by Camp Dresser and McKee (CDM).

Also enclosed is a fax transmittal sheet. I would appreciate it if you would take the time to fax this response to me as soon as you have logged in the above document and placed it with the rest of the file. This will help us to keep better track of the documents in the repositories.

Thank you in advance for your assistance in this matter. If you have any questions, please feel free to contact me.

Sincerely,

Brian von Gunten
Project Manager
Superfund Section
Environmental Response Division
517-373-6808

cc: P8

fax sent 9/18/00

Fax Transmittal Form

To: Brian von Gunten
Michigan Department of Environmental Quality
Environmental Response Division

Fax Number: (517) 335-4887

From: Saugatuck-Douglas Library

We have received and logged in the following documents:

Human Health Risk Assessment

Sincerely,

Joren McCaleb

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

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Executive Summary

This Executive Summary presents an overview of the Human Health Risk Assessment (HHRA) of the Allied Paper, Inc./Portage Creek/Kalamazoo River (API/PC/KR) Superfund Site. This HHRA presents the approach and assumptions used to develop quantitative estimates of risk and hazard. Risks and hazards were estimated for five populations: (1) sport angler - central tendency assumptions (2) sport anglers - high end assumptions; (3) subsistence anglers; (4) residents (5) recreationalists. Exposures to polychlorinated biphenyls (PCBs) from the site can result primarily from ingestion of fish or by direct contact with, or inhalation of, dust and volatile emissions from floodplain soil near three of the former river dams. In addition, exposures by recreational users of the river to sediments and surface water were evaluated semi-quantatively. Potential exposure to waterfowl, turtles and air above the surface water were found to be inadequately characterized by available data.

A fish advisory is currently in place on parts of the Kalamazoo River and Portage Creek (MDCH, 2000a). For the general population, on the Kalamazoo River between Morrow Pond Dam and Allegan Dam and on Portage Creek below Monarch Mill Pond, the advisory recommends no consumption of carp, catfish, suckers, smallmouth bass and largemouth bass and no more than one meal per week of all other species. For the general population, below Allegan Dam the advisory recommends no consumption of carp, catfish and northern pike, no more than one meal per week of largemouth and smallmouth bass, and unlimited consumption of all other species.

For nursing mothers, pregnant women, women intending to have children and children under 15 years of age, no consumption of any species is recommended for fish caught above Allegan Dam. For fish caught below Allegan Dam, the advisory recommends for women and children no consumption of carp, catfish, northern pike smallmouth bass and largemouth bass and suggests eating no more than one meal per month for all other species. Table E-1 presents the 2000 Michigan fish advisories for the API/PC/KR site. A survey of anglers on the Kalamazoo River was conducted by the Michigan Department of Community Health of the State of Michigan in 1994 *(Kalamazoo River Angler Survey and Biological Testing Study* (MDCH, 2000b)). Despite this advisory, this survey reported that anglers from Kalamazoo and Allegan Counties are eating on average two meals per month of various species including bass, catfish, panfish, bullheads and carp; more than ten percent (10%) of anglers are eating more than one meal per week of various species. This survey confirmed that the Kalamazoo River is an important recreational resource and, for certain subpopulations may serve as an important source of food.

TABLE F-1
MICHIGAN FISH ADVISORY FOR PCBs
API/PC/KR SITE

Water Body	Species	General Population									Women & Children								
		Length (inches)									Length (inches)								
		6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30+	6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30+
Kalamazoo River (From Battle Creek to Morrow Pond Dam)	Carp	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
Kalamazoo River (From Morrow Pond Dam to Allegan Dam) and Portage Creek (Below Monarch Mill Pond, Kalamazoo Co.)	Carp, Catfish, Suckers	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Largemouth and Smallmouth Bass					NC	NC	NC	NC						NC	NC	NC	NC	
	All other species	●	●	●	●	●	●	●	●	●	NC	NC	NC	NC	NC	NC	NC	NC	NC
Kalamazoo River (Below Allegan Dam)	Carp, Catfish	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC	NC
	Largemouth and Smallmouth Bass					●	●	●	●						NC	NC	NC	NC	
	Northern Pike							NC	NC	NC							NC	NC	NC
	All other species	UC	UC	UC	UC	UC	UC	UC	UC	UC	▬	▬	▬	▬	▬	▬	▬	▬	▬

Notes:
NC = No Consumption.
UC = Unlimited Consumption.
● = One meal per week.
▬ = One meal per month .

An HHRA has five steps:

- Data Evaluation
- Toxicity Assessment
- Exposure Assessment
- Risk Characterization
- Uncertainty Analysis

In the Data Evaluation, available fish data collected in 1993 and 1997 were compiled and reviewed. Data were collected for several species from 11 Aquatic Biota Study Areas (ABSAs), including smallmouth bass, a representative sport fish, and carp, a representative bottom feeder. Data for these species were used in the HHRA.

Smallmouth bass samples were analyzed with the skin on and carp were analyzed with the skin removed, which is most representative of the edible portions of fish prepared and consumed by anglers (USEPA, 1995a). While individual aroclors were analyzed, the HHRA was based on total polychlorinated biphenyls (PCBs). All detected aroclors were summed and a total PCB concentration was used to assess exposure and risk. The United States Environmental Protection Agency (EPA) recommends using total PCB data, given that all of the detected PCB aroclors have been associated with toxic effects.

In the Toxicity Assessment, the potential health effects of PCBs are evaluated and toxicological benchmarks are identified which can be used to quantify cancer risks and noncancer hazard. The potential health effects of PCBs include cancer, reproductive effects and immunological effects (ATSDR, 1996). Cancer slope factors, which are an indicator of a chemical's cancer potency, are used to quantify cancer risks. Reference doses (RfDs), or allowable doses, are used to measure the potential toxicity or non-cancer health hazard associated with exposure to a chemical for effects other than cancer. RfDs have been published for reproductive and immunological endpoints (USEPA, 1999).

PCBs are considered probable human carcinogens on the basis of animal studies of rats, which have shown a statistically significant increase in liver cancer, and human studies of capacitor workers which have shown a statistically significant increase in liver, gastrointestinal, skin and gall bladder cancers. While the number of observed cancers vs. expected cancers were higher in several human studies, a dose-response relationship could not be established with the human studies. (*Integrated Risk Information System*, USEPA, March 1999). Clear dose-response relationships were established for several aroclors in animal studies conducted by Brunner (Brunner et al., 1996). These studies form the basis of *PCBs: Cancer Dose-Assessment and Application to Environmental Mixtures* (EPA, 1996), whereby a range of cancer slope factors are proposed based on the persistence and bioaccumulation potential of PCBs in environmental media.

The Exposure Assessment involves developing exposure scenarios whereby people are coming into contact with contaminated materials or biota. While exposure to other media are likely to be taking place at the site, fish ingestion and contact with contaminated floodplain soils were the only exposure pathways for which a quantitative assessment of risk and hazard was conducted. Data were deemed inadequate to evaluate two exposure pathways: inhalation of particulate and vapor phase contamination, and ingestion of waterfowl.

Two scenarios were evaluated for floodplain soil exposures, the nearby resident scenario and the recreationalist scenario. The exposure assumptions used to evaluate the resident scenario are summarized below:

Assumption	Resident	Reference
Soil Ingestion	114 mg-yr/kg-day (age adjusted)	MDNR, 1995
Dermal Contact Rate	353 mg-yr/kr-day (age adjusted)	MDEQ, 2000
Inhalation Rate	7.52 m^3-yr/kg-day (age adjusted)	MDNR, 1995
Age	1-31 years	U.S. EPA, 1997
Fraction from Contaminated Source	1.0	Site-Specific
Exposure Frequency	350 days/year (ingestion) 245 days/year (dermal)	MDNR, 1995
Exposure Duration	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	U.S. EPA, 1997
Absorption Efficiency	0.14	U.S. EPA, 1998

The exposure assumptions used to evaluate the recreationalist scenario are summarized below:

Assumption	Resident	Reference
Soil Ingestion	2.8 mg-yr/kg-day 47 mg-yr/kg-day 34 mg-yr/kg-day	MDNR, 1995
Dermal Contact Rate	85 mg-yr/kg-day 61 mg-yr/kg-day	U.S. EPA, 1997b
Inhalation Rate	1.37 m^3-yr/kg-day 1.9 m^3-yr/kg-day	U.S. EPA, 1997b
Age	6 - 31 years	
Fraction from Contaminated Source	1.0	Site-Specific
Exposure Frequency	128 days	MDEQ, 2000
Exposure Duration	2 years (reproductive) 24 years (immunological) 24 years & 9 years (cancer)	U.S. EPA, 1997b U.S. EPA, 1997b U.S. EPA, 1996
Absorption Efficiency	0.14	U.S. EPA, 1998

Additional details on the derivation of these assumptions is presented in Section 3.5.2.

As identified by the Michigan Department of Natural Resources, major recreational uses of the Allegan State Game Area and other areas along the Kalamazoo river include:

1. Hunting and fishing
2. Canoeing
3. Picnicking
4. Mushroom picking, berry picking, and wild food gathering
5. Sightseeing
6. Wild animal observation/bird watching

Three exposure scenarios were developed for fish ingestion: (1) the sport anglers scenario - central tendency assumptions; (2) the sport angler scenario - high end assumptions; and (3) the subsistence angler scenario. The difference between the three fishing scenarios was reflected in different fish ingestion rates, exposure durations, species consumed, loss of PCBs during cooking and fractions of the total fish ingested that were from a contaminated source. These assumptions are summarized as follows:

Assumption	Central Tendency Sport Angler	High End Sport Angler	Subsistence Angler	Reference
Body Weight	70kg	70kg	70kg	EPA, 1997
Fish Ingestion Rate	0.015 kg/day (24 meals/year)	0.078 kg/day 125 meals/year	0.11 kg/day (179 meals/year)	West, 1993
Fraction from Contaminated Source	1.0	0.5	1.0	
Exposure Frequency	365 days/year	365 days/year	365 days/year	EPA, 1997
Exposure Duration Reproductive	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	30 years + 9 (cancer)* 30 years (noncancer) 2 years (reproductive)	30 years + 9 (cancer)* 30 years (noncancer) 2 years (reproductive)	EPA, 1994
Species	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Site Specific
Reduction Factor	0%	22%	22%	Zabik, 1995
Absorption Efficiency	100%	100%	100%	ATSDR, 1996

*9 years internal exposure added to external exposure (USEPA, 1996)

The two sport angler scenarios represent the central tendency and the high end portion of the risk distribution respectively, and the subsistence angler scenario represents an important subgroup of the fish eating population.

One other assumption for the central tendency angler was based on MDEQ Surface Water Quality Division guidance. The Division does not use a reduction factor to account for losses of PCBs during trimming or cooking of fish. For this reason, no reduction factor was used to characterize risks and hazards to the central tendency angler.

These assumptions were based on work previously conducted by USEPA Region V on Manistique Harbor, Michigan, Saginaw Bay, Michigan, and the Lower Fox River, Wisconsin Superfund sites. Fish ingestion rates for the sport angler are based on the *Great Lakes Water Quality Initiative Technical Support Document for Human Health Criteria and Values* (EPA, 1995). The fish ingestion rate of 15 grams per day, which is also used by the MDEQ Surface Water Quality Division to establish surface water quality standards, represents the mean value for sport anglers and the 90th percentile for the overall population in the Great Lakes. This value is consistent with data reported in the *Michigan Sport Angler Fish Consumption Studies* (West, 1989 and 1993) and the *Kalamazoo River Angler Survey* (MDHC, 1998) as a mean value for sport anglers. The HHRA quantified risks and hazard using these assumptions. For each scenario, and for each of 8 areas representing stretches of the River between dams, the risks associated with both average and maximum PCB concentrations detected in fish were estimated. For floodplain soil exposures, average and maximum concentrations of samples collected from behind the former impoundments of three dams (Trowbridge, Plainwell and Otsego) were used to calculate risk and hazard estimates for nearby residents. A 30-year residence period was assumed.

The Risk Characterization combines information from the data evaluation, toxicity assessment and exposure assessment to develop estimates of cancer risk and noncancer hazard. Cancer risks are expressed as a probability of an individual developing cancer from site-related exposures, or in this case, from ingesting fish or being exposed to floodplain soil. Noncancer risk is expressed as a hazard index, which is a ratio of the estimated dose of PCBs received from an exposure to the RfD, which is the dose below which adverse effects are not expected. Two noncancer endpoints were evaluated - reproductive health effects and immunological health effects.

USEPA has established an acceptable target range for carcinogenic risk of 1 in one million to 1 in 10,000, while for all Superfund sites, the acceptable risk level is established by the EPA Regional Administrator on a case by case basis. The Michigan Department of Environmental Quality (MDEQ) considers risk below 1 in 100,000 to be acceptable. Both USEPA and MDEQ consider hazard quotients below 1.0 to be acceptable.

Tables E-2 through **E-7** summarize the estimated risks and hazards for sport and subsistence anglers, residents, and recreationalists. Tables E-2 and E-3 present risks and hazards for anglers based on average and maximum fish concentrations, respectively. Tables E-4 and E-5 present risks and hazards for residents based on average and maximum concentrations, respectively. Table E-6 and E-7 present risks and hazards for recreationalists based on average and maximum concentrations, respectively.

Using both average and maximum fish concentrations, cancer risks for subsistence anglers in all study areas were outside (greater than) the USEPA target cancer risk range of 1 in 1 million to 1 in 10,000 and the MDEQ risk threshold of 1 in 100,000. Hazard quotients for subsistence anglers in all study areas were greater than the acceptable USEPA and MDEQ hazard quotient threshold of 1.0.

Using both average and maximum fish concentrations, cancer risks for both central tendency and high end sport anglers who consumed 100 percent smallmouth bass or 75 percent smallmouth bass and 25 percent carp were outside the USEPA target cancer risk range and exceeded the MDEQ cancer threshold for all ABSAs.

Using both average and maximum fish concentrations, hazard quotients for both central tendency and high end sport anglers who consume either 100 percent smallmouth bass or 75 percent smallmouth bass and 25 percent carp exceeded the USEPA and MDEQ hazard quotient threshold of 1.0 for both the immunological and reproductive endpoints.

Using average floodplain soil concentrations, cancer risks to residents in all three floodplain soil areas were within the USEPA target cancer risk range of 1 in 1 million to 1 in 10,000, but above the MDEQ cancer risk threshold of 1 in 100,000. Using maximum floodplain soil concentrations, cancer risks were outside the USEPA target cancer risk range and exceeded the MDEQ threshold.

Using both average and maximum floodplain soil concentrations, hazard quotients based on immunological endpoints for residents in all three floodplain soil areas exceeded the USEPA and MDEQ hazard quotient threshold of 1.0. Hazard quotients for the reproductive endpoint exceeded 1.0 using maximum concentrations for the Trowbridge and Plainwell areas. Hazard quotients using average concentrations did not exceed 1.0.

Using average floodplain soil concentrations, cancer risks to recreationalists in all three floodplain areas were within the USEPA target risk range and below the MDEQ cancer risk threshold. Using maximum floodplain soil concentrations, cancer risks were within the USEPA target risk range but above the MDEQ cancer risk threshold. The highest cancer risk using maximum concentrations was estimated for the Plainwell area where cancer risks were 5 in 100,000.

TABLE E-2
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
AVERAGE CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	1.3E-03	2.9E-03	2.3E-04	5.1E-04	4.6E-04	1.0E-03
		ABSA 6	Total PCBs	1.3E-03	2.2E-03	2.4E-04	3.9E-04	4.8E-04	7.9E-04
		ABSA 7	Total PCBs	2.0E-03	2.3E-03	3.5E-04	4.1E-04	7.1E-04	8.3E-04
		ABSA 8	Total PCBs	2.7E-03	3.5E-03	4.7E-04	6.2E-04	9.4E-04	1.3E-03
		ABSA 9	Total PCBs	2.6E-03	2.4E-03	4.5E-04	4.1E-04	9.2E-04	8.4E-04
		ABSA 10	Total PCBs	2.6E-03	4.5E-03	4.5E-04	7.9E-04	9.2E-04	1.6E-03
		ABSA 11	Total PCBs	1.0E-03	2.4E-03	1.8E-04	4.2E-04	3.7E-04	8.6E-04

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)

TABLE E-2(Continued)
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
AVERAGE CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient from Ingestion of Fish					
				Subsistence		Sport-Central Tendency		Sport-High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	17 (R) 58 (I)	37 (R) 130 (I)	2.9 (R) 10 (I)	6.5 (R) 23 (I)	5.9 (R) 21 (I)	13 (R) 46 (I)
		ABSA 6		17 (R) 60 (I)	29 (R) 100 (I)	3.0 (R) 11 (I)	4.9 (R) 17 (I)	6.1 (R) 21 (I)	10 (R) 35 (I)
		ABSA 7		26 (R) 90 (I)	30 (R) 100 (I)	4.5 (R) 16 (I)	5.2 (R) 18 (I)	9.1 (R) 32 (I)	11 (R) 37 (I)
		ABSA 8		34 (R) 120 (I)	46 (R) 160 (I)	6.0 (R) 21 (R)	7.9 (R) 28 (R)	16 (R) 42 (I)	16 (R) 56 (I)
		ABSA 9		33 (R) 120(I)	30 (R) 110 (I)	5.8 (R) 20 (I)	5.3 (R) 19 (I)	12 (R) 41 (I)	11 (R) 38 (I)
		ABSA 10		33 (R) 120 (I)	58 (R) 200 (I)	5.8 (R) 20 (I)	1.0 (R) 36 (I)	12 (R) 41 (I)	21 (R) 72 (I)
		ABSA 11		13 (R) 46 (I)	31 (R) 110 (I)	2.3 (R) 8.1 (I)	5.4 (R) 19 (I)	4.7 (R) 16 (I)	11 (R) 39 (I)

Notes: Target hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE E-3
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CAR	100% SMB	75% SMB / 25% CAR	100% SMB	75% SMB / 25% CAR
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	5.3E-03	9.9E-03	9.3E-04	1.7E-04	1.9E-03	3.5E-03
		ABSA 6	Total PCBs	5.0E-03	6.6E-03	8.7E-04	1.1E-03	1.8E-03	2.3E-03
		ABSA 7	Total PCBs	5.1E-03	6.0E-03	8.9E-04	1.1E-03	1.8E-03	2.1E-03
		ABSA 8	Total PCBs	5.7E-03	7.6E-03	1.0E-03	1.3E-03	2.0E-03	2.7E-03
		ABSA 9	Total PCBs	7.9E-03	8.2E-03	1.4E-03	1.4E-03	2.8E-03	2.9E-03
		ABSA 10	Total PCBs	3.3E-03	8.3E-03	5.8E-04	1/4E-03	1.2E-03	2.9E-03
		ABSA 11	Total PCBs	5.9E-03	1.0E-02	1.0E-03	1.8E-03	2.1E-03	3.7E-03

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)

TABLE E-3 (Continued)
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CAR	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	68 (R) 240 (I)	160 (R) 440 (I)	9.9 (R) 35 (I)	22 (R) 78 (I)	20 (R) 70 (I)	45 (R) 160 (I)
		ABSA 6	Total PCBs	64 (R) 220 (I)	84 (R) 300 (I)	11 (R) 38 (I)	14 (R) 52 (I)	23 (R) 80 (I)	29 (R) 100 (I)
		ABSA 7	Total PCBs	65 (R) 230 (I)	77 (R) 270 (I)	11 (R) 40 (I)	14 (R) 47 (I)	23 (R) 81 (I)	27 (R) 94 (I)
		ABSA 8	Total PCBs	73 (R) 260 (I)	97 (R) 340 (I)	13 (R) 45 (I)	17 (R) 59 (I)	26 (R) 91 (I)	34 (R) 120 (I)
		ABSA 9	Total PCBs	100(R) 360 (I)	100 (R) 370 (I)	18 (R) 62 (I)	18 (R) 64 (I)	36 (R) 130 (I)	37 (R) 130 (I)
		ABSA 10	Total PCBs	42 (R) 150 (I)	110 (R) 370 (I)	7.4 (R) 26 (I)	19 (R) 65 (I)	15 (R) 53 (I)	37 (R) 130 (I)
		ABSA 11	Total PCBs	75 (R) 260 (I)	130 (R) 460 (I)	13 (R) 46 (I)	23 (R) 81 (I)	27 (R) 93 (I)	47 (R) 160 (I)

Notes: Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE E-5
SUMMARY OF RISKS AND HAZARDS
FOR RESIDENTS LIVING NEAR EXPOSED FLOODPLAIN SOILS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk	Chemical	Non-Carcinogenic Hazard Quotient
				Exposure Routes Total [1]		Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	3.6E-04	Total PCBs	1.4 (R) 19 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	1.6E-04	Total PCBs	0.61 (R) 8.5 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	3.8E-04	Total PCBs	1.5 (R) 20 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE E-4
SUMMARY OF RISKS AND HAZARDS FOR RESIDENTS
LIVING NEAR EXPOSED FLOODPLAIN SOILS
AVERAGE CONCENTRATIONS
API/K/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk Exposure Routes Total	Chemical	Non-Carcinogenic Hazard Quotient Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	5.4E-05	Total PCBs	0.21 (R) 2.9 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	3.7E-05	Total PCBs	0.14 (R) 2.0 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	4.8E-05	Total PCBs	0.19 (R) 2.6 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE E-6
SUMMARY OF RISKS AND HAZARDS FOR RECREATIONAL VISITORS TO EXPOSED
FLOODPLAIN SOILS AVERAGE CONCENTRATIONS
API/K/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk	Chemical	Non-Carcinogenic Hazard Quotient
				Exposure Routes Total [1]		Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	7.3E-06	Total PCBs	0.023 (R) 0.31 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	5.0E-06	Total PCBs	0.016 (R) 0.21 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	6.4E-06	Total PCBs	0.021 (R) 0.27 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)

TABLE E-7
SUMMARY OF RISKS AND HAZARDS FOR RECREATIONAL VISITORS TO EXPOSED FLOODPLAIN SOILS MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk	Chemical	Non-Carcinogenic Hazard Quotient
				Exposure Routes Total [1]		Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	4.8E-05	Total PCBs	0.15 (R) 2.0 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	2.1E-05	Total PCBs	0.068 (R) 0.9 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	5.0E-05	Total PCBs	0.16 (R) 2.1 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)

Using average floodplain soil concentrations, hazard quotients based on both the immunological and reproductive endpoints were below the USEPA and MDEQ threshold of 1.0. Using maximum concentrations, hazard quotients based on the immunological endpoint exceeded the USEPA and MDEQ threshold for the Plainwell (2.1) and Trowbridge (2.0) areas; the hazard quotient for the Otsego area was 0.9. Using maximum concentrations, hazard quotients based on the reproductive endpoint were all below the hazard quotient threshold.

Risk-based fish concentrations (RBC_{fish}) and sediment concentrations (RBC_{sed}) were developed to be protective of sport and subsistence anglers. Risk-based floodplain soil concentrations (RBC_{soil}) were developed to be protective of residents living near exposed floodplain soil. RBCs were developed for both cancer and noncancer endpoints. Risk-based concentrations have been developed for PCBs using an allowable cancer risk of 1 in 100,000 and a noncancer hazard index of 1.0. **Table E-8** presents the risk-based and hazard-based fish concentrations (RBC_{fish}).

Concentrations are protective at a cancer risk level of 1 in 100,000 and a noncancer hazard index of 1.0. For central tendency sport anglers who consume up to 24 meals per year of fish, a fish concentration of 0.042 mg/kg is protective of cancer endpoints, a concentration of 0.075 mg/kg is protective of the noncancer immunological endpoint and a concentration of 0.26 mg/kg is protective of the noncancer reproductive endpoint. For high end sport anglers who consume up to 125 meals/year of fish, a fish concentration of 0.021 is protective of cancer endpoints, a concentration of 0.048 is protective of the noncancer endpoint, and a concentration of 0.16 mg/kg is protective of the noncancer reproductive endpoint. For subsistence anglers who consume up to 179 meals per year, a fish concentration of 0.008 mg/kg is protective of cancer endpoints, 0.016 mg/kg is protective of the noncancer immunological endpoint and 0.056 mg/kg is protective of the noncancer reproductive endpoint.

The Michigan Department of Community Health (MDCH) has established fish advisories for the general population, women and children. According to the MDCH criteria for placing fish on the Michigan Sport Fish Consumption Advisory for the general population, when between 11 and 49 percent of fish samples exceed 2 mg/kg of PCBs, a one meal per week advisory is issued. When more than 50 percent of fish samples exceed 2 mg/kg, a no consumption advisory is issued. For women of child bearing age and children under 15 years of age, at concentrations of greater than 0.05 mg/kg up to 0.2 mg/kg of PCBs in fish , a one meal per week advisory is issued. At concentrations greater than 0.2 mg/kg up to 1 mg/kg, a one meal per month advisory is issued.

TABLE E-8
RISK-BASED FISH FILLET CONCENTRATIONS (RBC_{fish}) (1)
API/PC/KR SITE

Receptor	RBC_{fish} Protective of 1E-05 Cancer Risk for PCBs (mg/kg)	RBC_{fish} Protective of 1.0 Hazard Index for PCBs (mg/kg)
Sport Angler - Central Tendency Assumes 24 meals/year 0.015 kg/day	0.042	0.075 (I) 0.26 (R)
Sport Angler - High End Assumes 125 meals/year 0.078 kg/day	0.021	0.048 (I) 0.16 (R)
Subsistence Angler Assumes 179 meals/year 0.11 kg/day	0.008	0.016 (I) 0.056 (R)

(1) Concentrations protective of both carp and smallmouth bass.
(I): Immunological Endpoint
(R): Reproductive Endpoint

The MDCH considers their PCB fish advisory concentration of less than or equal to 0.05 mg/kg in fish to be protective at an ingestion rate of 225 meals per year (0.14 kg/day) for the general population for noncancer endpoints. The MDCH does not base its advisory on cancer risk, due to political and pragmatic considerations. For subsistence anglers, who have been reported to consume between 3-4 meals per week, the RBC_{fish} developed in this HHRA indicate that concentrations in the range of 0.08 (cancer) and 0.016 (noncancer) are needed to be protective of health. The differences between the derivations of the two noncancer values are listed in the following table:

	MDCH	HHRA
Meals/year	225	179
Average daily fish consumption (kg)	0.14	0.11
Reduction by cleaning/cooking (%)	50	22
Weight of subject (kg)	70	70
Target dose, HPV or RfD (µg/kg/day)	0.05	0.02
PCB level in fish (mg/kg)	0.05	0.016

Most of the difference between the two results can be attributed to the difference between the health protection value (HPV) used by the MDCH (0.05 µg/kg/day) and the U.S. EPA RfD used in the HHRA (0.02 µg/kg/day). These values were derived from the same data by different methodologies. The Great Lakes Fish Advisory Task Force used a "weight of evidence" approach to derive the HPV used by the MDCH from data on a wide range of health effect endpoints. The U.S. EPA derives RfDs from data on specific endpoints with uncertainty and modifying factors added.

The MDCH Division of Environmental Epidemiology has reviewed this document and considers it to be adequately consistent with the MDCH protocol for issuing fish consumption advisories. Although there are differences between the cleanup levels and the MDCH first Level of Concern as cited above, MDCH considers the parameters and assumptions used in the two derivations are reasonable, the resulting levels to be reasonably close, and the cleanup levels to be more protective than the MDCH Level of Concern. MDCH acknowledges the U.S. EPA and MDEQ's authority to establish the cleanup levels to be used at any site.

Table E-9 presents the risk-based and hazard-based sediment concentrations (RBC_{soil}). The RBC_{fish} were used to develop RBC_{sed}. RBC_{sed} represent the sediment concentrations protective of fish that are consumed at the ingestion rates specified for sport and subsistence anglers. The RBC_{sed} were developed using the biota-to-sediment accumulation factor (BSAF) method presented in Region V EPA guidance (Pelka, 1998). RBC_{sed} range from 0.52 mg/kg protective of sport anglers who consume 100 percent game fish such as bass to 0.075 mg/kg protective of subsistence anglers who consume 100 percent bottom feeding fish such as carp.

TABLE E-9
RISK-BASED SEDIMENT CONCENTRATION (RBC_{sed}) [1]
(mg/kg sediment)
API/PC/KR SITE

Scenario	RBC_{sed} Protective of Fish Ingestion at 1E-05 Cancer Risk For PCBs (mg/kg)		RBC_{sed} Protective of Fish Ingestion at 1.0 Hazard For PCBs Quotient (mg/kg)	
	Bass [2]	Bass/Carp[3]	Bass [2]	Bass/Carp[3]
Sport Angler - Central Tendency	0.52	0.42	0.93 (I) 3.2 (R)	0.75 (I) 2.6 (R)
Sport Angler - High End	0.26	0.21	0.6 (I) 2.0 (R)	0.48 (I) 1.6 (R)
Subsistence Angler	0.093	0.075	0.20 (I) 0.70 (R)	0.16 (I) 0.57 (R)

(1) Incorporates fillet to whole body conversion factor of 0.25 for bass and 0.4 for carp.

(2) Assumes 3 percent lipid.

(3) Assumes 6 percent lipid.

Table E-10 presents the risk-based floodplain soil concentration (RBC_{soil}) protective of residents. For the cancer endpoint the RBC_{soil} is 2.6 mg/kg. For noncancer endpoints, the RBC_{soil} is 8.5 mg/kg for the reproductive endpoint and 3 mg/kg for the immunological endpoint.

Table E-11 presents the risk-based floodplain soil concentration (RBC_{soil}) protective of recreationalists. For the cancer endpoint, the RBC_{soil} is 17 mg/kg. For noncancer endpoints, the RBC_{soil} is 35 mg/kg for the reproductive endpoint and 32 mg/kg for the immunological endpoint.

As with any health risk assessment, certain assumptions were made which introduce uncertainty into the results and conclusions. Principal sources of uncertainty include the representative exposure concentrations in fish, the toxicity and carcinogenicity of PCBs in environmental mixtures versus laboratory studies, and the degree of exposure including duration of exposure and fish ingestion rates. Assumptions are made using best professional judgement and the scientific literature on risk assessment.

TABLE E-10
RISK-BASED FLOODPLAIN SOIL CONCENTRATIONS (RBC_{SOIL})
PROTECTIVE OF RESIDENTS
API/PC/KR SITE

Receptor	RBC_{soil} Protective of 1E-05 Cancer Risk (mg/kg)	RBC_{soil} Protective of 1.0 Hazard Quotient (mg/kg)
Resident	2.6	8.5 (R) 5.0 (I)

Notes (R) = Reproductive endpoint
(I) = Immunological endpoint

TABLE E-11
RISK-BASED FLOODPLAIN SOIL CONCENTRATIONS (RBC_{SOIL})
PROTECTIVE OF RECREATIONAL VISITORS
API/PC/KR SITE

Receptor	RBC_{soil} Protective of 1E-05 Cancer Risk (mg/kg)	RBC_{soil} Protective of 1.0 Hazard Quotient (mg/kg)
Recreationalist	17	35 (R) 32 (I)

Notes: (R) = Reproductive endpoint
(I) = Immunological endpoint

Section 1
Introduction

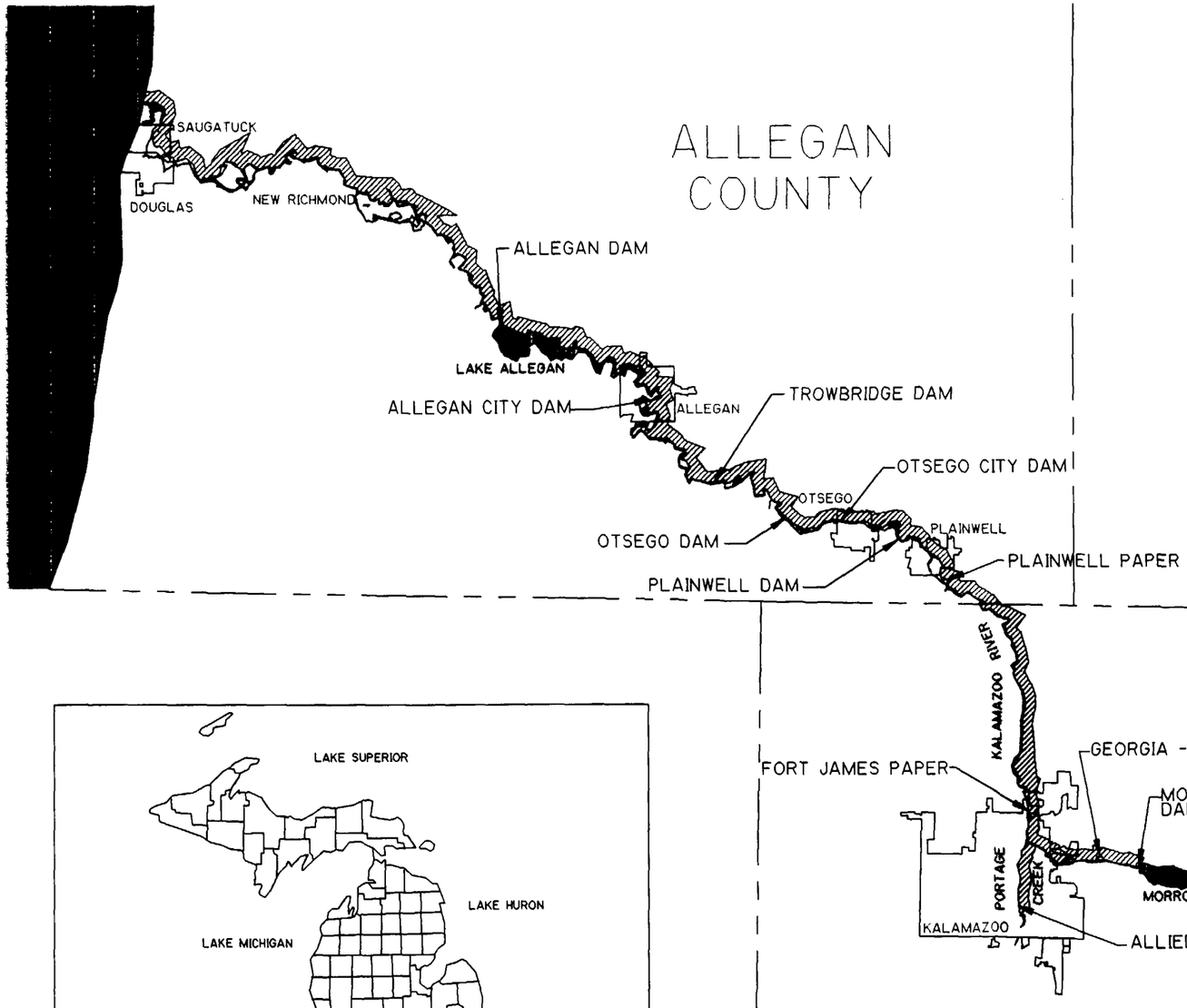
This document presents the human health risk assessment (HHRA) for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (API/PC/KR) in Southwestern Michigan. **Figure 1-1** presents the extent of the site study area. This assessment is based on concentrations of polychlorinated biphenyls (PCBs) detected in media at the site, exposure assumptions, and toxicity information, which together are used to characterize risks to human receptors. Risks are estimated based on existing (baseline) conditions, that is, in the absence of any remedial action and institutional controls. This information is intended for use by risk managers in determining acceptable clean-up levels to protect human receptors.

1.1 Report Objectives

The objective of the HHRA is to assess potential current and foreseeable future risks associated with PCB exposure to people who may recreate on and near the river and along the floodplain, and who may live near the river and along the floodplain. Specifically, the objectives of the HHRA are to:

- Define the sources of contamination;
- Identify human receptors of concern;
- Evaluate all exposure pathways and eliminate those not deemed significant;
- Quantitatively evaluate significant exposure pathways;
- Determine the extent and likelihood of actual or potential impacts;
- Describe the uncertainty associated with the risk and hazard estimates;
- Develop risk-based fish concentrations protective of human health; and
- Develop risk-based sediment and floodplain soil concentrations; protective of human health; and
- Help determine whether response actions are necessary.

Exposures to the following media were evaluated: (1) exposed former sediments/floodplain soil; (2) sediment; (3) surface water; (4) biota, including fish and waterfowl; and (5) air. This HHRA estimates cancer and non-cancer risks for those exposure pathways considered potentially significant. In an effort to focus resources on those pathways with the greatest hazard potential, potentially significant pathways were determined by means of a comparison of API/PC/KR site data with similar data collected from the Lower Fox River and Lower Green Bay Estuary in Wisconsin. A full-scale quantitative HHRA was conducted for these water bodies under the direction of the Wisconsin Department of Natural Resources (WDNR).



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KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT
STUDY AREA

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Figure No. 1-1

Assuming similar exposure assumptions would be used for the Michigan and Wisconsin sites, pathways found to be significant in the Lower Fox/Green Bay site were evaluated in the API/PC/KR assessment, unless detected concentrations were substantially lower at the API/PC/KR site.

1.2 Scope

This human health risk assessment (HHRA) evaluates the potential current and foreseeable future risks to people who may recreate on or live near the Kalamazoo River and its floodplain. The range of possible exposures to the river water, sediment, biota and floodplain soil were examined. For some types of exposure, a quantitative assessment of cancer risk and noncancer hazard was conducted. For other types of exposure, only a qualitative evaluation was conducted because previous investigations for a similar site found these exposures to not be associated with a significant risk, given similar or higher media concentrations.

PCB contamination is the primary focus of this HHRA and the primary chemical of concern at the site. This HHRA focuses on the following two populations:

- people who may recreate on or near the Kalamazoo River and the floodplain
- people who may live near the Kalamazoo River and the floodplain

A separate HHRA has been conducted for the King Highway Landfill Operable Unit, a Georgia Pacific property along the Kalamazoo River (BB&L, 1996; BB&L, 1997).

1.3 Report Organization

This HHRA is being conducted under contract to the Michigan Department of Environment Quality (MDEQ) and follows guidance and directives issued by both the MDEQ and the United States Environmental Protection Agency (USEPA).

The organization of this report follows the general format outlined in Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part A). The remainder of this report is organized as follows:

- Section 2 - Data Evaluation
- Section 3 - Exposure Assessment
- Section 4 - Toxicity Assessment
- Section 5 - Risk Characterization
- Section 6 - Uncertainty Assessment

- Section 7 - Determination of Risk - Based Sediment and Floodplain Soil Concentrations
- Section 8 - References

Section 2
Data Evaluation

This human health risk assessment (HHRA) evaluates the potential current and foreseeable future risks to people who may recreate on or live near the Kalamazoo River and its floodplain. The range of possible exposures to the river water, sediment, biota and floodplain soil were examined. For some types of exposure, a quantitative assessment of cancer risk and noncancer hazard was conducted. For other types of exposure, only a qualitative evaluation was conducted because previous investigations for a similar site found these exposures to not be associated with a significant risk, given similar or higher media concentrations.

This section evaluates the available data collected on and near the API/PC/KR site and makes a determination as to whether the data are adequate for conducting a quantitative or qualitative risk assessment.

2.1 Data Evaluation

Samples have been collected from fish, turtle, sediment, and surface water from the Kalamazoo River since 1971. The majority of the data used in this Human Health Risk Assessment (HHRA) were collected in 1993 and 1997 and were reported in various technical memoranda prepared by Blasland, Bouck & Lee, including Draft Technical Memorandum 12 - Former Impoundment Sediment and Geochronological Dating Investigation; Draft Technical Memorandum 14 (and addenda) - Biota Investigation; and Draft Technical Memorandum 5 - Willow Boulevard/A-Site Operable Unit: Results of Air Investigation.

Exposures to fish, turtle, floodplain soil, sediment, surface water, air and waterfowl were considered in this risk assessment. Based on a review of these data, one of the following determinations was made:

- Quantitative evaluation of the associated exposure pathways is needed;
- Qualitative evaluation of the associated exposures pathways is sufficient; or
- Additional data are needed to adequately evaluate the associated exposure pathways.

2.1.1 Fish Data

Fish data were collected in 1993 and 1997 as part of the Biota Investigation (BB&L, 1994e; BB&L, 1998). Several species of fish were collected including smallmouth bass, golden redhorse, carp, spotted and white suckers. These data have been summarized and discussed in Ecological Risk Assessment for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Camp Dresser & McKee Inc., June 1999).

Two species, smallmouth bass and carp, were selected to represent a popular targeted sport fish and a bottom feeding fish in the human health assessment. Skin-off fillet data were used for carp and skin-on fillet data were used for smallmouth bass. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories* (USEPA, 1995) recommends that samples be prepared in a manner that best represents the edible portions of fish prepared and consumed by anglers. Concentrations of polychlorinated biphenyls (PCBs) detected in fish are presented in **Table 2-1** for each of the seven areas evaluated in this risk assessment. To aid in the evaluation of aquatic habitats and chemical exposure, the API/PC/KR site was divided into 12 Aquatic Biota Study Areas (ABSAs). Nine of these ABSAs were evaluated as exposure areas in the HHRA. A list of the ABSAs is presented on **Table 2-2**. Three ABSAs, 3,4, and 5, cover the area between Morrow Dam and Plainwell Dam. Data from these three ABSAs were combined for purposes of this assessment because it is assumed that fish can migrate within these areas, but due to the presence of the dams, will not migrate between these areas. All data sets represent a stretch of the river between two dams. **Figures 2-1** through **2-4** present the fish data collected from the nine study areas evaluated in this assessment.

Between 11 and 22 samples were collected for each ABSA. Quality control data is presented in Draft Technical Memorandum 14 - Biota Investigation (BB&L, 1994) and generally conforms to the data quality objectives established for the site. For these reasons, the fish data sets were considered adequate for risk assessment purposes. Because fish ingestion is the primary exposure pathway of concern for this site, this pathway was evaluated quantitatively.

2.1.2 Turtle Data

Ingestion of snapping turtles is known to occur in the vicinity of the site. While not well documented, the quantities of turtles ingested by individuals are believed to be less than the quantities of fish ingested. Eleven turtle samples were collected from ABSAs 5 and 10. Detected concentrations of PCBs in turtles were reported in the Biota Investigation. Aroclor 1260 was detected in 11 out of 11 samples from ABSA 5; and 9 out of 11 samples from ABSA 10. Aroclor 1254 was detected one time in a sample from ABSA 10 at 0.53 mg/kg. Concentrations of Aroclor 1260 ranged from 0.021 to 0.49 mg/kg at ABSA 1; 0.23 to 1.9 mg/kg at ABSA 5; and 0.11 to 8.1 mg/kg at ABSA 10. The turtles were collected from May 16 through May 21, 1994. Because samples were collected in the spring, lipid levels would likely be at their lowest. Similarily, concentrations of PCBs which accumulate in the fatty tissue would also be lower at this time of year. Turtle samples collected later in the summer or fall would likely exhibit higher lipid levels and, therefore higher PCB levels. The available data may under-represent PCB concentrations to which people ingesting turtles caught later in the summer and fall would be exposed.

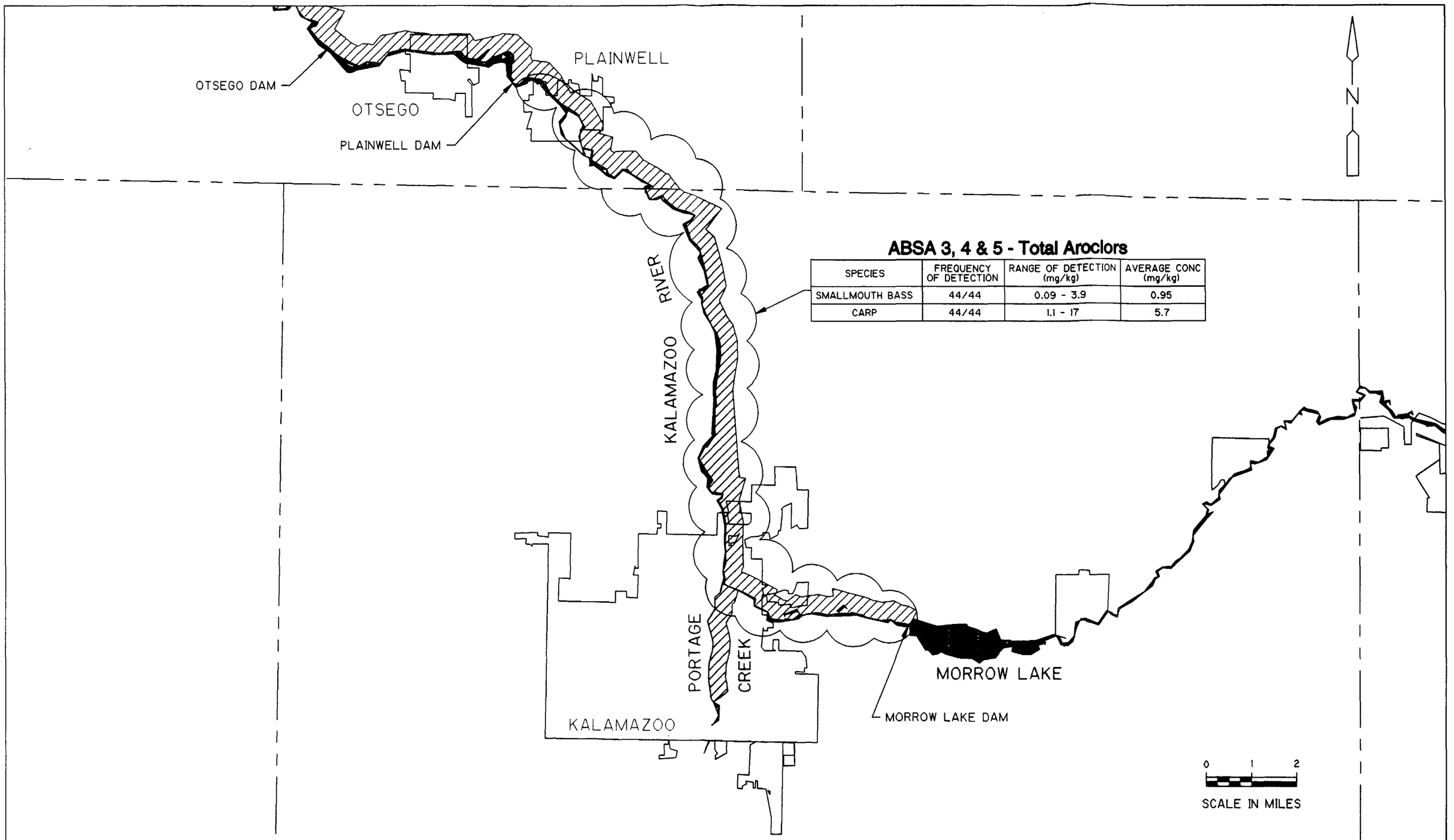
TABLE 2-1
SMALLMOUTH BASS AND CARP DATA
API/PC/KR SITE

AREA / SPECIES	TOTAL AROCLOR			
	Frequency of Detection	Range of Detection (mg/kg)	Average Conc. (mg/kg)	Maximum Conc. (mg/kg)
ABSA 3,4,5 Combined				
Small Mouth Bass	44/44	0.09 - 3.9	0.95	3.9
Carp	44/44	1.1 - 17	5.7	17
ABSA 6				
Small Mouth Bass	11/11	0.27 - 3.7	0.98	3.7
Carp	11/11	1.1 - 8.0	3.4	8.0
ABSA 7				
Small Mouth Bass	11/11	0.39 - 3.7	1.4	3.7
Carp	11/11	0.71 - 6.4	2.4	6.4
ABSA 8				
Small Mouth Bass	11/11	0.74 - 4.2	1.9	4.2
Carp	11/11	1.3 - 9.6	4.6	9.6
ABSA 9				
Small Mouth Bass	22/22	0.23 - 5.8	1.9	5.8
Carp	22/22	0.099 - 6.5	1.2	6.5
ABSA 10				
Small Mouth Bass	11/11	1.1 - 2.4	1.9	2.4
Carp	11/11	1.9 - 17	7.6	17
ABSA 11				
Small Mouth Bass	21/22	0.13 - 4.3	0.74	4.3
Carp	22/22	0.36 - 17	4.8	17

ABSA: Aquatic Biota Study Area. See Table 2-2 for description of ABSAs.

TABLE 2-2
API/PC/KR BIOLOGICAL STUDY AREAS

ABSA 3	Kalmazoo River from Morrow Dam to Mosel Ave., Kalamazoo Aquatic biota were collected just downstream of Morrow Dam.
ABSA 4	Kalamazoo River at Mosel Ave. to Hwy. 131 bridge. Aquatic biota were collected from the Kalamazoo River near Mosel Avenue.
ABSA 5	Kalamazoo River near Hwy 131 bridge to Plainwell Dam. Aquatic biota were collected from the Kalamazoo River upstream of Plainwell Dam. Includes TBSAs 8,9, and 10.
ABSA 6	Kalamazoo River from Plainwell Dam to Ostego City Dam. Aquatic biota were collected from the Kalamazoo River upstream of Ostego City Dam. Includes TBSA 10.
ABSA 7	Kalamazoo River from Ostego City Dam to Ostego Dam. Aquatic biota were collected just upstream of Ostego Dam.
ABSA 8	Kalamazoo River from Ostego Dam to Trowbridge Dam. Aquatic biota were collected upstream of Trowbridge Dam. Includes TBSA 3 and 5.
ABSA 9	Kalamazoo River from Trowbridge Dam to Lake Allegan Dam. Aquatic biota were collected from Lake Allegan.
ABSA 10	Kalamazoo River from Lake Allegan Dam to Ottawa Marsh. Aquatic biota were collected downstream of Allegan Dam. Includes TBSA 1.
ABSA 11	Kalamazoo River from Ottawa Marsh to US 31. Aquatic biota were collected near Saugatuck.



ABSA 3, 4 & 5 - Total Aroclors

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	44/44	0.09 - 3.9	0.95
CARP	44/44	1.1 - 17	5.7

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ABSA 3, 4 & 5

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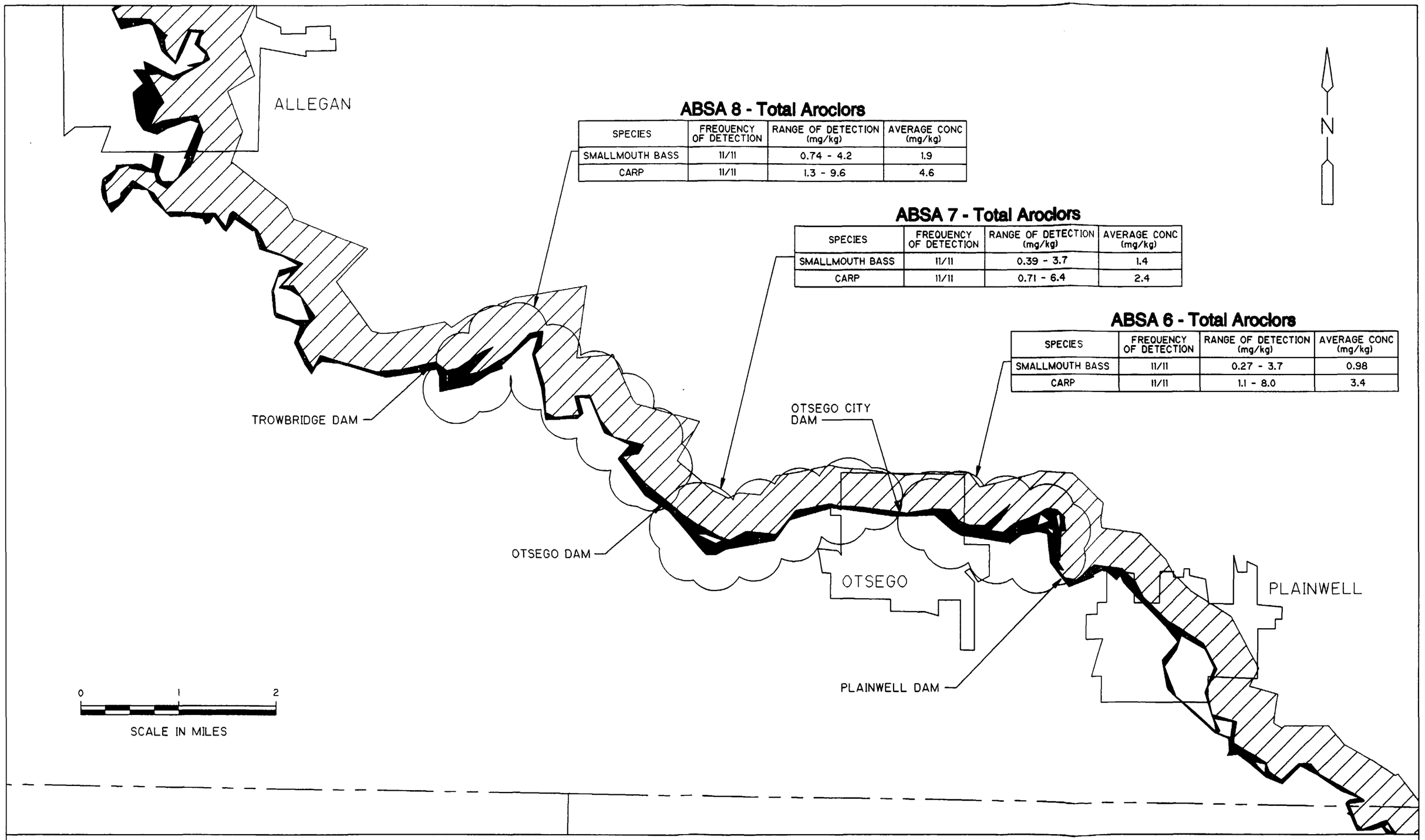
Figure No. 2-1



ABSA 8 - Total Aroclors

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	11/11	0.74 - 4.2	1.9
CARP	11/11	1.3 - 9.6	4.6

ABSA 7 - Total Aroclors

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	11/11	0.39 - 3.7	1.4
CARP	11/11	0.71 - 6.4	2.4

ABSA 6 - Total Aroclors

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	11/11	0.27 - 3.7	0.98
CARP	11/11	1.1 - 8.0	3.4

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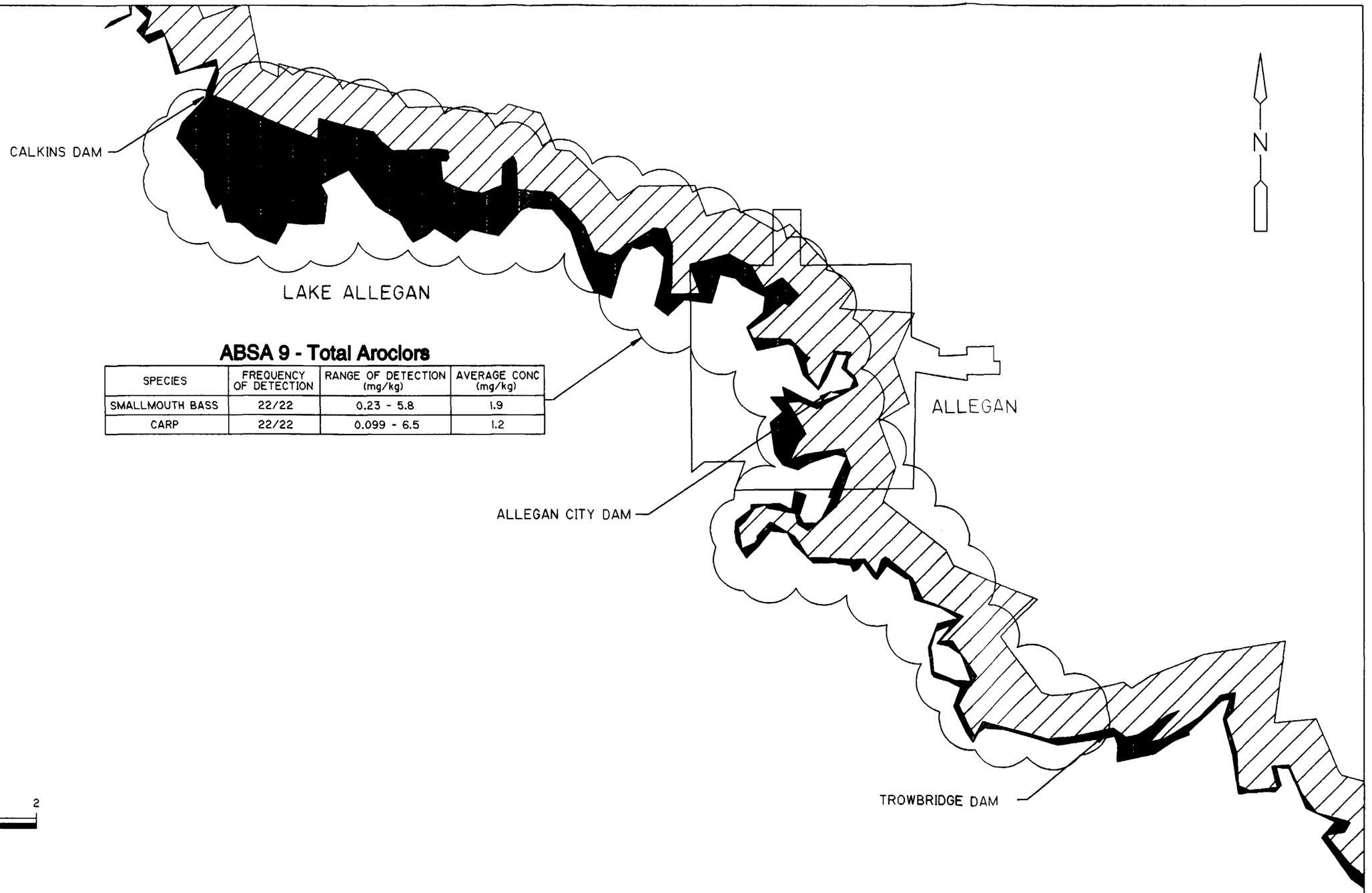
Figure No. 2-2



ABSA 9 - Total Aroclors

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	22/22	0.23 - 5.8	1.9
CARP	22/22	0.099 - 6.5	1.2

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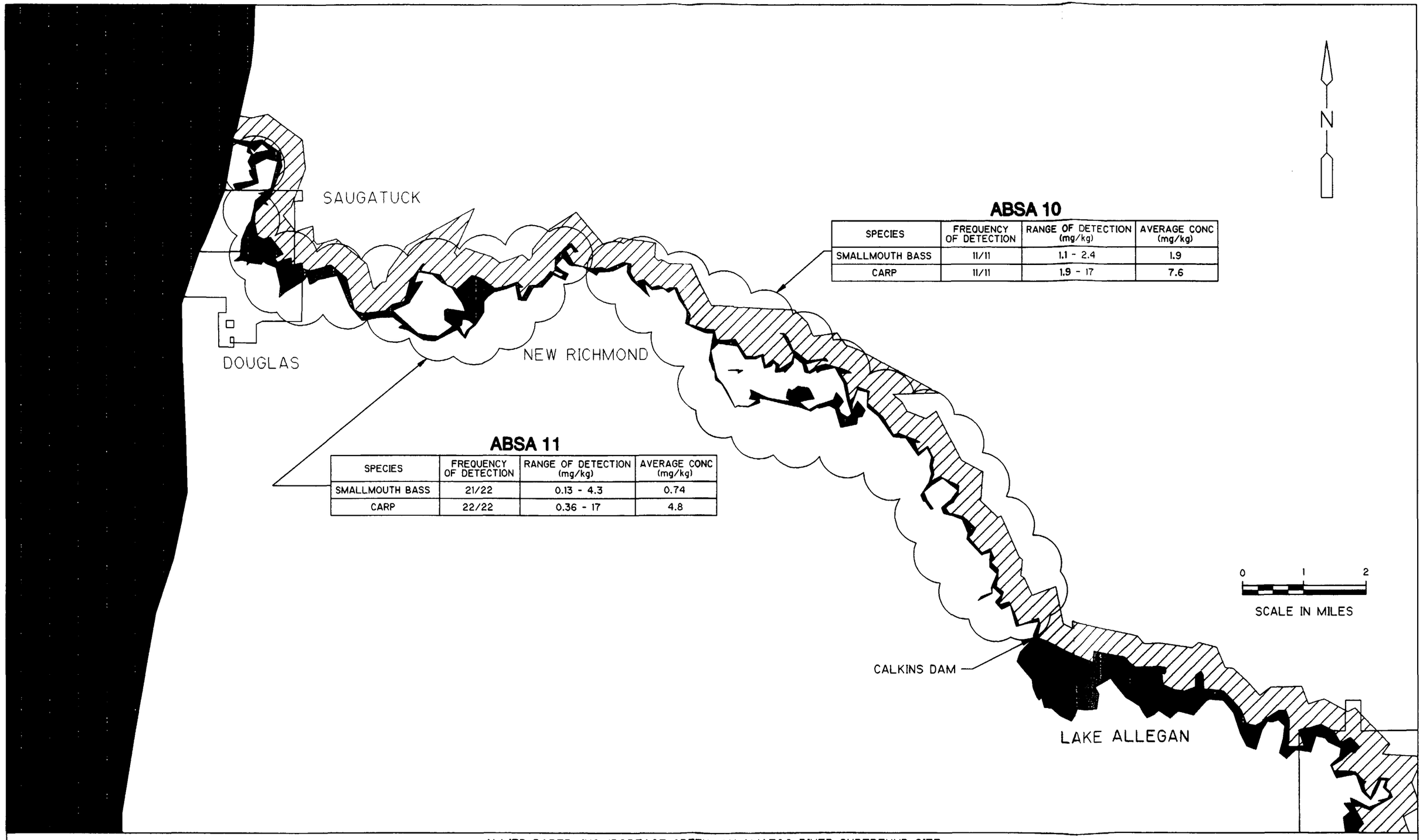
Figure No. 2-3



ABSA 10

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	11/11	1.1 - 2.4	1.9
CARP	11/11	1.9 - 17	7.6

ABSA 11

SPECIES	FREQUENCY OF DETECTION	RANGE OF DETECTION (mg/kg)	AVERAGE CONC (mg/kg)
SMALLMOUTH BASS	21/22	0.13 - 4.3	0.74
CARP	22/22	0.36 - 17	4.8

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KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT
ABSA 10 & 11

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Figure No. 2-4

While PCB concentrations in turtles caught later in the season may be higher, detected PCB concentrations in turtles were generally less than those detected in fish. Fish concentrations of total PCBs ranged from 1.1 to 2.4 mg/kg in smallmouth bass and 1.9 to 17 mg/kg in carp. Turtle ingestion rates are assumed to be less than fish ingestion rates, therefore, the risks associated with turtle ingestion would be less than, or comparable to, those associated with fish ingestion. Lack of truly representative turtle data represents a data deficiency that could result in the underestimation of risks and hazards.

2.1.3 Waterfowl

A limited number of waterfowl samples have been collected from the Kalamazoo River. In 1985, the U.S. Fish and Wildlife Service (USFW) collected 12 mallards, 2 wood duck, 1 Canada goose, and 1 blue-winged teal from Otsego City Impoundment, Trowbridge Impoundment, Allegan State Game area, and Saugutuck. Samples were analyzed for Aroclor 1260. These data are reported in Kalamazoo River Action Plan (MDNR, 1987). Detected concentrations ranged from 0.60 mg/kg in an immature mallard from Saugatuck to 4.8 mg/kg in an adult mallard from Otsego City Impoundment. Also in 1985, the USFW collected 2 mallards from the Kalamazoo River and 9 mallards from the Potawatomie Marsh. Samples were analyzed for total PCBs which were detected in one sample at a concentration of 0.29 mg/kg. These data sets are included in Appendix B.

Based on the age of these data sets and their limited nature, these data have not been used to estimate risks to hunters. This exposure pathway is considered important for the Kalamazoo River area as hunting waterfowl is a widespread recreational activity. Additional data are needed to adequately evaluate risks to this population. This pathway will be evaluated in an addendum to the HHRA.

2.1.4 Floodplain Soil/Sediment

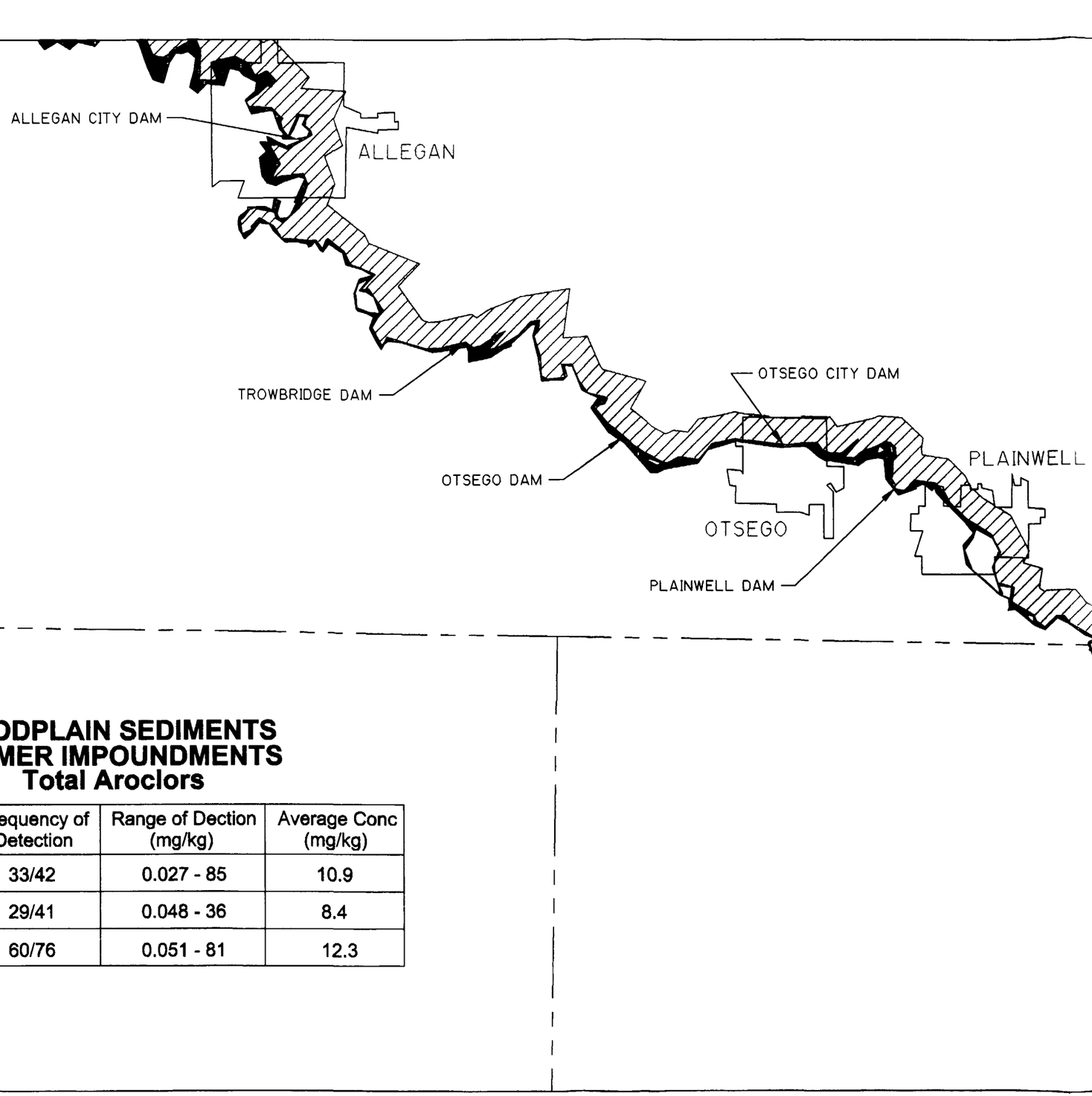
The Kalamazoo River has been dammed in five places within the API/PC/KR. From the 1950s through the 1970s the paper companies discharged PCB contaminated effluent to the Kalamazoo River. The impoundments acted as setting basins where PCB wastes settled out on the bottom of the impoundments. Three of these dams, Plainwell, Otsego, and Trowbridge, and their impoundments, were acquired by the State of Michigan in the late 1960's. The impoundments were drained in the early 1970's thereby exposing sediments previously overlain by river water. These exposed sediments are part of the API/PC/KR.

The exposed floodplain soils in the vicinity of the former Plainwell, Otsego and Trowbridge dams cover approximately 61, 37, and 346 acres, respectively. Samples obtained from 0-6 inches were evaluated as it is this horizon which is most accessible to people living nearby. **Table 2-3** summarizes the floodplain data for these three areas. **Figure 2-5** presents these exposed floodplain areas. The highest PCB concentrations were detected in the Plainwell area, followed by Trowbridge and Otsego. The frequency of detection was above 80 percent for all areas indicating that

TABLE 2-3

FLOODPLAIN SOIL DATA
API/PC/KR SITE

	TOTAL AROCLOR			
AREA	Frequency of Detection	Range of Detection (mg/kg)	Average Conc. (mg/kg)	Maximum Conc. (mg/kg)
PLAINWELL	33/42	0.027 - 85	10.9	85
OTSEGO	29/41	0.048 - 36	8.4	36
TROWBRIDGE	60/76	0.051 - 81	12	81



FLOODPLAIN SEDIMENTS
FORMER IMPOUNDMENTS
Total Aroclors

Areas	Frequency of Detection	Range of Dection (mg/kg)	Average Conc (mg/kg)
PLAINWELL	33/42	0.027 - 85	10.9
OTSEGO	29/41	0.048 - 36	8.4
TROWBRIDGE	60/76	0.051 - 81	12.3

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT
FLOODPLAIN SEDIMENTS

CDM
environmental engineers, scientists, planners, & management consultants

Figure No. 2-5

deposition of contamination was widespread in these areas. Due to the proximity of residential areas to these areas of exposed sediment, exposures associated with floodplain sediment/soil are quantitatively evaluated in the HHRA.

2.1.5 River Sediment

Over 1000 instream cores have been collected from 151 transects in the river. Five to nine samples were collected from each transect and 365 samples were analyzed for PCBs, total organic carbon, grain size, and percent solids. These data were collected as part of the Remedial Investigation and were reported in Draft Technical Memorandum 10 - Sediment Characterization/Geostatistical Pilot Study (BB&L, 1994a).

Based on an evaluation prepared by the MDCH, and a review of data and risks associated with sediment exposures at the Lower Fox River site, it has been determined that exposure to instream sediments during recreational activities is not an important means of exposure to PCBs. In Health Consultation for Allied Paper/Portage Creek/Kalamazoo River (MDCH, 1997), prepared under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) (July 2, 1997), it is stated that "moist sediments might adhere more strongly to skin than drier soil, but river water would tend to wash the sediments off before the soiled skin reaches the mouth or food". It is also stated that "based on the PCB concentrations reported in the sediment and water of the Kalamazoo River and considering the frequency of exposure to the sediments, and limited absorption of PCBs from soils, there is no need to restrict access to the sediment and water of the Kalamazoo River".

For the reasons stated in the MDCH document, exposure to instream sediments is not considered an important exposure pathway and therefore has not been evaluated in this HHRA.

2.1.6 Surface Water

Surface water concentrations of PCBs have been reported in Draft Technical Memorandum 16 - Surface Water Investigation (BB&L, 1995a) and the description of the Current Situation (BB&L, 1992) . The maximum and central tendency (median) PCB concentrations reported in surface water in the most recent of these reports are 0.000071 μg/l and 0.000025 μg/l, respectively. All detected concentrations are below drinking water Maximum Contaminant Levels (MCLs) published by USEPA. The MCL for PCBs is 0.5 micrograms per liter (μg/l). The Kalamazoo River is not used for drinking water, however, incidental ingestion could occur during swimming. The quantity of water consumed during swimming has been estimated to be significantly less than consumed when water is used for drinking water (50 millimeters/hour which is a typical swimming event vs. 2 liters/day) (USEPA, 1989). MDEQ has established a surface water criterion for PCBs of 0.00012 μg/l protective of wild life and a criterion protective of human health of 0.000026 μg/l. Water concentrations detected in the Kalamazoo have exceeded the criterion protective of human health, however, exposures via direct contact and incidental ingestion of surface water are

not considered significant pathways and were not further evaluated in this HHRA. Further rationale for elimination of these pathways is presented in Section 3.2.

2.1.7 Air

No air data have been collected in the immediate vicinity of the River or exposed floodplain soils. An air investigation was conducted at the Willow Boulevard/A-Site Operable Unit (OU) located in Kalamazoo Township, Michigan. As reported in Draft Technical Memorandum 5 - Willow Boulevard/A-Site Operable Unit: Results of the Air Investigation, the air investigation involved collection of 15 samples over a three month period from 5 perimeter samplers and 2 background location samplers. The objectives of the air investigation were to (1) identify the highest representative PCB concentrations expected for adjacent or nearest public access and residential locations; and (2) provide data necessary to determine whether PCBs are migrating from the operable unit via the air pathway.

Sampling of both particulate phase and vapor phase PCBs according to standard USEPA protocols was conducted using glass-fiber filters and high-volume polyurethane foam (PUF) cartridges, respectively. The results of the air investigation are presented in Appendix C. Arithmetic average concentrations of PCBs ranged from 0.00049 $\mu g/m^3$ to 0.0029 $\mu g/m^3$, below the secondary risk screening level of 0.02 $\mu g/m^3$ developed by the MDEQ Air Quality Division. At the time of sampling, the Willow Boulevard/A-Site OU was partially vegetated. Conditions have since changed and the site is no longer vegetated but is covered with a temporary soil cover.

These data are not appropriate for evaluating risks and hazards associated with exposures to particulates or volatile emissions from the River or exposed floodplain soils. In order to evaluate potential risks and hazards associated with air exposures, a quantative estimate of particulate and volatile emission from the exposed floodplain soil has been conducted using algorithms adapted from *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, (ASTM, 1995). These exposures are evaluated as part of the residential scenario. Exposures to volatile emissions from surface water have not been evaluated. In the absence of air data or air modeling, to characterize this exposure pathway overall site risks are likely to be underestimated.

Section 3
Exposure Assessment

3.1 Site Description

The API/PC/KR site is located in a moderately dense demographic area. The Kalamazoo River is a class A water body and is used for swimming, boating and fishing. Restrictions against development along the river have not been established outside of the 100 year floodplain. Land use along the river includes urban commercial and industrial; urban, suburban and rural residential; agricultural; and recreational (MDPH, 1991).

In addition to fishing and boating, recreational activities identified by the Michigan Department of National Resources along the Kalamazoo River include:

- Canoeing
- Picnicking
- Mushroom and berry picking
- Wild food gathering
- Sightseeing/wild animal observation
- Birdwatching

The primary source of contamination at the site is PCB residuals which were discharged into the river system by several paper mill facilities located upstream. In the de-inking phase of recycling paper fibers, specialty inks containing PCBs were liberated. Much of the de-watered paper waste was disposed of in landfills and sludge disposal areas located on the banks of the river. Erosion from these facilities, as well as direct discharge of millions of gallons per day of effluent into the river, has resulted in an estimated mass of over 22,700 pounds of PCBs in floodplain and instream sediments.

The site contains six dams, three of which are owned by the MDNR, and three, which are owned by municipalities and private entities. These dams (in a downstream order) are: Plainwell Dam, Otsego City Dam, Ostego Dam, Trowbridge Dam, Allegan City Dam and Caulkins Dam on Lake Allegan. The Plainwell, Otsego and Trowbridge dams are the three MDNR dams. While these dams impounded water, PCB-contaminated sediments were deposited in the impoundments. When the superstructures of these dams were removed in 1986 and the water level was lowered to the sill, most of these contaminated sediments were exposed in the floodplain. These exposed sediments are continuously being eroded into the Kalamazoo River and constitute a continual source of PCBs to the river system. The largest acreage of exposed sediments is behind the Trowbridge Dam. Residential property can be found adjacent to the exposed sediments behind the Trowbridge and Otsego Dams. In some areas, the gray paper residual waste can be observed in the backyards of residential homes along the river. Additionally, the

construction of the golf course behind the Trowbridge impoundment has occurred on top of and immediately adjacent to the exposed sediments containing paper residual waste. Established gardens have been observed in the former impoundment area behind Otsego Dam.

These dams, along with the Caulkins dam, have been identified as areas where local anglers can go to catch fish in the Kalamazoo River. These structures provide attractive habitat for fish and many anglers have been observed fishing in the vicinity of these dams, including establishing fishing locations on the exposed sediments. In addition to attracting anglers, the three MDNR impoundments have also attracted waterfowl hunters, as evident by the duck blinds observed in the backwaters behind the existing structures.

Floodplain and river sediments are both transport and exposure media. River sediments are a source of exposure to aquatic biota such as fish and turtles and floodplain sediments are a source of exposure for people living, recreating, or working on the river bank. For purposes of this evaluation, residents who live near the exposed floodplain soils were considered the most highly exposed. Risk and hazard quotient estimates for these individuals will serve as a conservative representation of risk and hazard to individuals using the river bank for commercial or recreational purposes.

PCBs are transported via river sediment and floodplain soil to secondary transport and exposure media including surface water, air and fish. Subsequent exposures, either directly to the river and floodplain soil, or to the secondary exposure media, includes: ingestion of fish, sediment or soil and surface water; dermal contact with sediment or soil and surface water; and inhalation of particulates and/or vapor emissions from exposed sediments.

Subsistence and recreational anglers, recreational users of the river for purposes other than fishing, and residents who may live near or on the river, were considered in the HHRA. An exposure scenario defines a particular manner in which people are exposed to contamination. An example of an exposure scenario includes: (1) ingestion of fish by subsistence anglers; and (2) ingestion of, dermal contact with and inhalation of particulates and vapors from floodplain soil by nearby residents. Some of the possible exposure scenarios for the API/PC/KR site were evaluated quantitatively, i.e., numerical estimates of cancer risk and noncancer hazard were developed. Some of the possible exposure scenarios were evaluated qualitatively, i.e., a discussion of the significance of a particular pathway or adequacy of the data to evaluate the pathway was provided.

3.2 Determination of Exposure Pathway Significance

Researchers have investigated the role of various environmental pathways of exposure to contaminants in the Great Lakes. Several multimedia studies indicated that most (80-90%) cases of human exposure to chlorinated organic compounds occur through the food pathway. A more recent multimedia study supports these findings and indicates

that the primary pathway of exposure to PCBs is from fish consumption (Birmingham, et al. 1989; Newhook, et al 1988; Fitzgerald et al. 1996).

Pathways involving ingestion of biota including fish and waterfowl have been determined to warrant quantitative evaluation. During hunting or fishing activities contact with River surface water and sediment may occur. Contact with surface water and sediment may also occur during other recreational activities such as swimming and boating. In general, contact with sediment and surface water does not result in significant risks or hazards. This assumption is consistent with the findings presented in *Health Consultation for Allied Paper/Portage Creek/Kalamazoo River* prepared by Michigan Department of Community Health (MDCH, 1997). In that document it is stated that "moist sediments might adhere more strongly to skin than drier soil, but river water would tend to wash the sediments off before the soiled skin reaches the mouth or food." In addition, the quantity of water consumed during swimming has been estimated to be significantly less than that consumed when water is used for drinking water (50 milliliters/hour which is a typical swimming event vs. 2 liters/day) (USEPA, 1992). For this reason, the ingestion of surface water is not considered a significant pathway.

In order to confirm that contact with in-stream sediment and surface water would not result in significant risks or hazards, site data from the API/PC/KR were compared to data from the Lower Fox River in Wisconsin. Exposure conditions at the two sites are very similar in that both sites have active recreational populations involved in fishing, hunting and boating and residential populations living on or near the site. An HHRA conducted for the Lower Fox River evaluated numerous pathways and found that the following four exposure pathways were associated with significant risk or hazard:

- Ingestion of fish by subsistence anglers
- Ingestion of fish by recreational anglers
- Ingestion of waterfowl by hunters
- Inhalation of outdoor air from surface water by nearby residents

Significant risk is defined as a level above the MDEQ cancer risk threshold of 1 in 100,000 excess lifetime cancer risks and significant hazard is defined as a hazard quotient greater than 1.0.

With the exception of inhalation of outdoor air from surface water, and ingestion of waterfowl by hunters, these pathways were quantitatively evaluated for the API/PC/KR site. Additional data are needed to adequately evaluate ingestion of waterfowl by hunters and volatilization from surface water to outdoor air. Exposure pathways involving contact with surface water and sediment i.e., the recreational wader or swimmer, were not associated with significant risk or hazard. Drinking water ingestion was evaluated for the Lower Fox River, but water from the Kalamazoo River is not used for drinking water, therefore this pathway is not relevant.

Table 3-1 presents upper bound and average concentrations of PCBs in sediment, surface water, fish, and waterfowl at the Lower Fox River and API/PC/KR sites. Upper bound and average concentrations for all abiotic and biotic media are higher from the API/PC/KR site than from the Lower Fox River site.

Scaling allows for estimation of risks or hazards for the Kalamazoo River using the Lower Fox River as a baseline. Exposure assumptions for recreational swimmers, waders, sport anglers and subsistence angler are comparable to the two sites. Risks and hazards are directly proportional to exposure concentrations. The ratio of exposure concentrations to risks or hazards for the Lower Fox is used to estimate the risks or hazards associated with the API/PC/KR exposure concentrations. **Table 3-2** presents scaled risks and hazards for the Kalamazoo River receptors associated with exposure to upperbound in-stream sediment and surface water. Using this procedure, it was determined that, even though the exposure concentrations for surface water and in-stream sediment in the API/PC/KR were higher than the Lower Fox, exposure pathways involving contact with in-stream sediment and surface water would not result in risks or hazard which exceeded regulatory thresholds. The complete comparison of Lower Fox River and API/PC/KR exposure concentrations and the results of the risk and hazard scaling are presented in Appendix D.

3.3 Receptors

Recent data compiled through the Agency for Toxic Substances and Disease Registry (ATSDR) Great Lakes program indicate the following:

- Approximately 4.7 million people consumed Great Lakes sport-caught fish within the past year.
- Knowledge of and adherence to health advisories for sport-caught fish vary across different populations.
- Advisory awareness is especially low in women and minority populations.
- Fish are an essential component of the diets of minority and Native American populations; they consume fish that tend to have higher levels of contaminants, and their cooking practices increase their exposure to Great Lakes contaminants compared to recommended fish preparation techniques (Johnson, 1998).

This information was used to identify the five receptor groups which have been evaluated in this HHRA:

- Subsistence anglers
- Central Tendency Sport anglers
- High end sport anglers

Table 3-1
Comparison of Total PCB Concentrations of Lower Fox River and Kalamazoo River API/PC/KR Site

Medium	Upper Bound (1)		Central Tendency (2)	
	Fox River	Kalamazoo	Fox River	Kalamazoo
Fish Tissue (mg/kg)	5.1(8)	17.34 (max-carp) 5.8 (max-smb)	3.97	7.6 (carp) 1.9 (smb)
Waterfowl Tissue (mg/kg)	1.7(9)	4.8 (max)	0.54	1.7
Surface Water (mg/L)	2.4E-05(6)	7.1E-05 (max)	2.2E-05	2.5E-05 (median)
Sediment (mg/kg)	5.5(7)	156 (max-ABSA 7) 13.6 (U95, ABSA 7)	5.4	3.7 (5)

(1) Upperbound measure concentrations - lower of the 95% UCL on the arithmetic mean or the maximum detected concentration. For particular data points from the Fox River Study, use of 95% UCL or maximum concentrations could not be discerned.
(2) Central Tendency = the arithmetic mean except for Kalamazoo surface water which is median value.
(3) Lower Fox River data from ThermoRetec, 1999
(4) Kalamazoo River data derived from following sources:
Fish (BB&L, 1995b; BB&L 1998)
Waterfowl (MDNR, 1987);
Surface Water (BB&L, 1995a);
Sediment (BB&L, 1994a)
(5) Average from ABSAs 3,4,5,6,7,8,9 as reported in CDM, 1999 originally derived from BB&L, 1994a.
(6) Upperbound concentration from DePere to Green Bay reach.
(7) Upperbound concentration from Little Lakes Buttes des Morts reach.
(8) Upperbound fish tissue concentration from Little Lake Butte des Morts reach. Species not reported.
(9) Upperbound concentration from Little Rapids to DePere reach.

TABLE 3-2
COMPARISON OF CALCULATED FOX RIVER RISKS AND HAZARDS TO SCALED KALAMAZOO RIVER RISKS AND HAZARDS
API / PC/ KR SITE

Pathway	Media	Fox River Calculated Risks		Fox River Calculated Hazards		Kalamazoo River Scaled Risks		Kalamazoo River Scaled Hazards	
Recreational Angler	Surface Water (ingestion, dermal contact)	1.7E-08 - 1.2E-07	(1)	1.0E-03 - 6.0E-03	(1)	1.2E-07 - 3.5E-07	(2)	2.2E-03 - 2.9E-02	(2)
Subsistence Angler	Surface Water (ingestion, dermal contact)	2.4E-08 - 1.6E-07	(1)	2.0E-03 - 8.0E-03	(1)	2.8E-08 - 4.7E-07	(2)	5.4E-02 - 3.9E-02	(2)
Recreational Swimmer	Surface Water (ingestion, dermal contact)	6.8E-08	(3)	1.4E-02	(3)	2.0E-07	(4)	4.1E-02	(4)
	Sediment (ingestion, dermal contact)	8.7E-08	(3)	2.5E-02	(3)	5.8E-08 - 2.1E-07	(5)	1.7E-02 - 6.2E-02	(5)
Recreational Wader	Surface Water (ingestion, dermal contact)	7.8E-09	(3)	2.0E-03	(3)	2.3E-08	(4)	9.8E-03	(4)
	Sediment (ingestion, dermal contact)	1.9E-07	(3)	2.5E-02	(3)	1.3E-07 - 4.7E-07	(5)	1.7E-02 - 6.2E-02	(5)

Notes:
(1): Based on range of calculated cancer and noncancer risks associated with the Average Concentration and the Upperbound Concentration..
(2): Based on scaled cancer and noncancer risks associated with the Average Concentration and the Maximum Concentration.
(3): Based Upperbound Concentrations (either on 95% UCL. Or maximum).
(4): Based on Maximum Concentrations.
(5): Based on range of calculated cancer and noncancer risks associated with the Average Concentration and the 95% UCL.

- Nearby residents
- Recreationalists

3.3.1 Subsistence Anglers

Subsistence anglers are individuals who would not be able to meet their daily nutritional requirements if they could not supplement their diet with sport-caught fish. In a survey financed by the Michigan Great Lakes Protection Fund, *Michigan Sport Anglers Fish Consumption Study*, 1991-1992 (West, 1993), a sample of 7,000 persons with Michigan fishing licenses was drawn and surveys were mailed in two-week cohorts from January 1991 - January 1992. Respondents were asked to report consumption patterns during the proceeding 7 days. A response rate of 46.8 percent was reported with 2,681 surveys returned. Fish consumption rates were found to be higher among minorities, people with low income, and people residing in small communities.

Three subpopulations of subsistence anglers have been evaluated in several studies of the Great Lakes region:

- Low-income/minorities
- Native Americans
- Hmong

Out of a total estimated population of 329,912, West 1993 estimated a low income (<$25,000) population of 99,094 and a minority/low income population of 9,022.

The Michigan Department of Community Health conducted the Kalamazoo River Angler Survey and Biological Testing Study. The study, which was funded by the ATSDR, involved field surveys conducted from May - September 1994 and interviews of 938 anglers in Kalamazoo and Allegan counties. Information on income level was not reported, though unemployment rates were reported. Unemployment rates for anglers in Allegan county (20.5%) and Kalamazoo county (17.4%) were higher than the overall unemployment rates for these counties (MDCH, 2000b). Respondents were questioned on age, education, race (white, non-white), gender, smoking status, drinking status, weight change and awareness of fish advisories.

Almost 4 percent of the Allegan County anglers reported that they fished for food only while none of the Kalamazoo County anglers reported that they fished for food only. An additional 10.6 percent of all anglers responded that they fished for both food and recreation (MDCH, 1998).

Allegan and Kalamazoo County public health agency staff conducted the interviews. Interviewers reported they were unable to interview Hmong anglers that have been observed fishing in the Lake Allegan area. At other Superfund sites, this segment of the population makes up a large component of the subsistence fishing population. Two key studies, *Hmong Fishing Activity and Fish Consumption* (Hutchinson and Kraft, 1994) and *Fish Consumption by Hmong Households in Sheboygan, Wisconsin*

(Hutchinson, 1994) examined fishing activity and fish consumption rates in Green Bay, Wisconsin and Sheboygan, Wisconsin, respectively.

Native American anglers were not specifically targeted in the Kalamazoo Angler Survey although an early draft of the survey reported that 9 percent of 143 male respondents in Allegan County were Native American and 0.5 percent of 213 male respondents in Kalamazoo County were Native American. A number of studies have been conducted on the fish ingestion rates of Native American populations in Alaska (Wolfe and Walker, 1987); the Columbia River Basin (CRITFC, 1994); Wisconsin (Peterson et.al, 1994; Fiore, 1989); and the St. Lawrence River (Fitzgerald, 1995, 1996).

The Lower Fox River HHRA evaluated four different subsistence fishing scenarios:

- Low income, minority (based on West, 1993 data)
- Native American Angler (based on Peterson, 1994 and Fiore, 1989)
- Hmong (based on Hutchinson and Kraft, 1994)
- Hmong (based on Hutchinson, 1998)

The overall ingestion rates and exposure frequencies for the low income, minority angler were the highest of these four scenarios; risks and hazards for the low income, minority angler were also the highest of these four scenarios. For this reason, the subsistence scenario for the API/PC/KR site is based on the low income, minority population.

3.3.2 Sport anglers

Fishing is a popular recreational activity on the Kalamazoo River. Because multimedia studies have indicated that most (80 - 90 percent) cases of human exposure to chlorinated organic compounds occur through the food pathway and the primary pathway of exposure is from fish consumption, risks and hazards to the sport angler population were evaluated in this HHRA.

The Kalamazoo River is a favorite fishing site for sport anglers and subsistence fishermen. The Kalamazoo River is a favorite angling site for smallmouth bass in the Kalamazoo area.

Additionally, the downstream reaches of the Kalamazoo River, below Caulkins dam is known for it steelhead and salmon fishing. The Kalamazoo River is also popular for catching carp, panfish, channel catfish and sucker species (personal communication with Jim Dexter, MDNR).

Anglers have been observed fishing in the vicinity of the three MDNR dams on a regular basis, and the Trowbridge dam has a boat launch ramp used by anglers and duck hunters to access the backwater areas behind this impoundment. There is limited fishing on Lake Allegan as the area has poor habitat, and most fishing is restricted to channel catfish, carp, and occasional panfish.

Two populations of sport anglers were evaluated: the central tendency sport angler and the high end sport angler. Assumptions regarding fish ingestion rates, reduction of PCBs due to cooking fish, portion of fish caught from the contaminated area are different for the central tendency and high end sport anglers. These assumptions are further discussed in Sections 3.5.2.

3.3.3 Nearby Residents

Urban, suburban and rural residential populations exist along stretches of the Kalamazoo River. Development within the 100-year floodplain is restricted; however, despite inclusion of 80 miles of the Kalamazoo River in the study area of the API/PC/KR National Priority List site, residential, commercial and recreational development along the river has proceeded unrestricted.

Exposed floodplain soil in the vicinity of the former Trowbridge, Otsego, and Plainwell dams are completely accessible to the public and are located adjacent to residential areas. For these reasons, a residential scenario was evaluated for these three floodplain areas.

3.3.4 Recreationalists

Some parts of the former impounded areas abut neighborhoods and residential property and are completely accessible to children and adults. Other areas are relatively less accessible to children but are accessible to adults who may engage in recreational activities such as birdwatching, picnicking, and hunting. The former impoundment areas near the Trowbridge, Otsego and Plainwell dams are accessible for these activities. For these reasons, a recreational scenario was evaluated for these floodplain areas.

3.4 Exposure Pathways

Figure 3-1 presents a site conceptual model for the API/PC/KR site. The conceptual model identifies all of the potential receptors and exposure pathways. Exposure pathways are the mechanisms by which people are exposed to chemicals from a site. A pathway is the route between a receptor and a contaminated medium. Some exposure pathways were evaluated qualitatively, i.e., a discussion of the relative insignificance of these pathways was provided to support eliminating them from further consideration. Some pathways were evaluated quantitatively, i.e., numerical estimates of cancer risk and noncancer hazard were generated. The receptors and exposure pathways quantitatively evaluated for this site include:

- Sport anglers - fish ingestion
- Subsistence anglers - fish ingestion

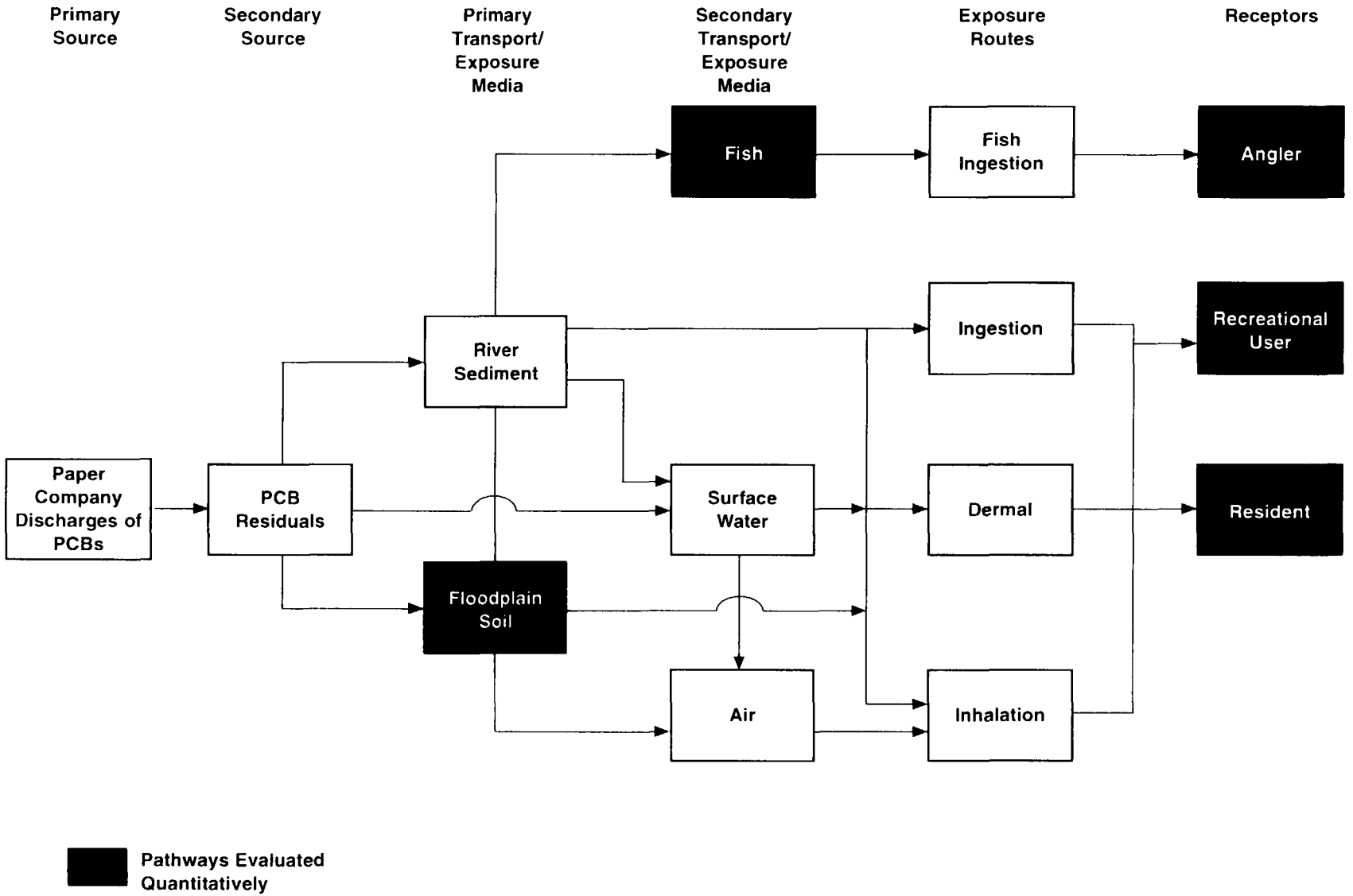


Figure 3-1
Site Conceptual Model
API/PC/KR Site

- Residents living adjacent to exposed floodplain soil - incidental ingestion of, dermal contact with and inhalation of particles and the volatile fractions of floodplain soil.

- Recreationalists exposed to floodplain soil - incidental ingestion of, dermal contact with and inhalation of particles and the volatile fractions of floodplain soil.

The Kalamazoo River is used for swimming, boating and fishing. While a fish consumption advisory has been issued by the Michigan Department of Community Health, the advisory is not legally binding, and local health officials and other local government representatives reported observing frequent fishing activity within the contaminated zone of the river (MDCH, 1999). Subsistence level consumption of fish from the river cannot be ruled out.

Fish ingestion is the primary exposure pathway for the API/PC/KR site. PCBs bioaccumulate in the food chain. Ingestion of fish is likely to result in higher exposures and greater risks than direct exposures to sediment and surface water containing PCBs. Exposure to floodplain soils is also considered to be significant, and was evaluated quantitatively due to the close proximity of residential areas to the floodplain soils.

The recreational user of the river is likely exposed to in-stream sediment and surface water during swimming or wading activities or to floodplain soil, including soils near the three former MDNR impoundments during other recreational activities.

A number of recreational activities are undertaken along the Kalamazoo River including hunting, picnicking, mushroom and berry picking, and bird watching. Hunting seasons for the following animals draw recreationalists to the banks of the Kalamazoo from September through May: rabbit (September 15 - March 31); deer (archery: October 1- November 14; firearm: November 15-30; muzzleloading: December 10-19); grouse (September 15 - November 14 and December 1 - January 1); squirrel (September 15 - January 1); turkey (October 4 - November 9 and April 12 - May 31); woodcock (September 25 - November 8); fox (October 15 - March 1) and raccoon (October 1 - January 31). Exposure to floodplain soil is considered significant for both nearby residents and recreationalists, therefore recreational exposures to floodplain soils was evaluated quantitatively.

The significance of exposures to in-stream sediment and surface water is considered low due to the relatively low surface water and sediment ingestion rates associated with swimming and wading, the low solubility of PCBs in water, and limited absorption through the skin.

Two exposure pathways have not been fully evaluated in this HHRA due to a lack of data. The Kalamazoo River Watershed area is used extensively to hunt duck and other waterfowl. A limited and potentially outdated data set exists to quantitatively

evaluate this pathway. It is recommended that additional data be collected to determine the potential risks to hunters who ingest duck and other waterfowl.

Volatilization of PCBs from surface water to air has been evaluated in previous risk assessments conducted on sites similar to the API/PC/KR. In the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River, Wisconsin* (ThermoRetec Consulting Corporation, 1999), risk estimates for this exposure pathway were above the USEPA risk thresholds. Maximum and average concentrations in the Kalamazoo River are higher than those detected in the Fox River, indicating that risks may be higher for the APR/PC/KR site. This pathway will be evaluated in an addendum to this HHRA.

3.5 Exposure Assumptions

In order to estimate risks and hazard to people, the degree and nature of exposures to chemicals must first be characterized. Information and assumptions on frequency of exposure, duration of exposure, and consumption rates are used to estimate the doses received by people who eat contaminated fish or who live, work or play on contaminated soils. These exposure assumptions are the result of surveys and studies conducted on the behaviors of individuals and groups such as subsistence and sport anglers, and residents. Some exposure assumptions are also based on EPA and MDEQ guidance.

3.5.1 Generalized Assumptions

Tables 3-3, 3-4 and **3-5** summarize the exposure assumptions for sport and subsistence anglers, residents near floodplain soil, and recreationalists respectively. Body weight is a standard exposure factor for adult males specified in the Exposure Factors Handbook (EPA, 1997). The soil ingestion rate, dermal contact rate and inhalation rate are age-adjusted rates for individuals from 1-31 years of age. These exposure assumptions, along with the exposure frequency and duration for residential exposures, are given as standard default assumptions for the residential scenario in Environmental Response Division Interim Operational Memorandum #18: Generic Soil Direct Contact Criteria (MDEQ, 2000). For ingestion of soil by nearby residents, it is assumed that exposure takes place year-round because soil from outdoors sources can be entrained into the indoor environment as indoor dust. Ingestion of soil by recreationalists is assumed to occur only on days when they are on the site, i.e., 4 days per week for 32 weeks, or 128 days per year. Dermal exposure is limited to periods during which there is no snow cover preventing contact (MDNR, 1995).

For recreationalists, soil ingestion is based on 100 milligrams ingestion for each day of exposure. The unitized ingestion rate is derived as follows:

100 mg/day * exposure duration / 70 kilograms bodyweight

The dermal contact rate for recreationalists assumes epxosures of the face, forearms and hands and a soil adherence factor of 0.07. The unitized dermal contact rate is derived as follows:

2572 cm2 * 0.07 * exposure duration / 70 kilograms bodyweight

Table 3-3
Exposure Assumptions for Sport and Subsistence Anglers
API/PC/KR Site

Assumption	Central Tendency Sport Angler	High End Sport Angler	Subsistence Angler	Reference
Body Weight	70kg	70kg	70kg	EPA, 1997
Fish Ingestion Rate	0.015 kg/day (24 meals/year)	0.078 kg/day 125 meals/year	0.11 kg/day (179 meals/year)	West, 1993
Fraction from Contaminated Source	1.0	0.5	1.0	
Exposure Frequency	365 days/year	365 days/year	365 days/year	EPA, 1997
Exposure Duration Reproductive	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	EPA
Species	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Smallmouth bass (100%) & Smallmouth bass/Carp (75%) (25%)	Site Specific
Reduction Factor	0%	22%	22%	Zabik, 1995
Absorption Efficiency	100%	100%	100%	ATSDR, 1996

Table 3-4
Exposure Assumptions for Residents Near Floodplains Soils
API/PC/KR Site

Assumption	Resident	Reference
Soil Ingestion	114 mg-yr/kg-day (age adjusted)	MDNR, 1995
Dermal Contact Rate	353 mg-yr/kr-day (age adjusted)	MDEQ, 2000
Inhalation Rate	7.52 m^3-yr/kg-day (age adjusted)	MDNR, 1995
Age	1-31 years	EPA, 1997
Fraction from Contaminated Source	1.0	Site-Specific
Exposure Frequency	350 days/year (ingestion) 245 days/year (dermal)	MDNR, 1995
Exposure Duration	30 years + 9 (cancer) 30 years (noncancer) 2 years (reproductive)	EPA, 1997
Absorption Efficiency	0.14	USEPA, 1998(a)

Table 3-5
Exposure Assumptions for Recreationalists on Floodplain Soil

Assumption	Resident	Reference
Soil Ingestion	2.8 mg-yr/kg-day 47 mg-yr/kg-day 34 mg-yr/kg-day	MDNR, 1995
Dermal Contact Rate	85 mg-yr/kg-day 61 mg-yr/kg-day	U.S. EPA, 1997b
Inhalation Rate	1.37 m^3-yr/kg-day 1.9 m^3-yr/kg-day	U.S. EPA, 1997b
Age	6 - 31 years	
Fraction from Contaminated Source	1.0	Site-Specific
Exposure Frequency	128 days	Site-Specific
Exposure Duration	2 years (reproductive) 24 years (immunological) 24 years & 9 years (cancer)	U.S. EPA, 1997b U.S. EPA, 1997b U.S. EPA, 1996
Absorption Efficiency	0.14	U.S. EPA, 1998

Additional details on the derivation of these assumptions are presented in Section 3.5.2.

The inhalation rate for recreationalists is assumes an hourly inhalation rate for moderate activities of 1.0 m3. The unitized inhalation rate is derived as follows:

1.0 m3/hour * 4 hours/day * exposure duration / 70 kilograms bodyweight

3.5.2 Specific Exposure Assumptions

3.5.2.1 Fish Ingestion Rates

A key factor in assessing the risks and hazard associated with ingestion of sport-caught or subsistence -caught fish is the ingestion rates of the sport and subsistence anglers. Two key studies of the fish ingestion behaviors of anglers in the Great Lakes region were conducted by Patrick West of the University of Michigan: Michigan Sport Anglers Fish Consumption Survey (1989) and Michigan Sport Anglers Fish Consumption Study (1993). In 1989, West surveyed a stratified random sample of Michigan residents with fishing licenses. Each of 18 cohorts received a questionnaire one week apart between January and May 1989. The survey included both a short-term recall component and a usual frequency component. The respondents were also asked to recall serving size based on comparison with a picture of a cooked 8 ounce fish portion. A total of 2,334 survey questionnaires were delivered and 1,104 were completed and returned giving a 47.3 response rate. Average fish consumption by age group, education level, place and years of residence were reported. Because the study was conducted in the winter and spring, it may underestimate fish ingestion rates, although respondents were asked to recall year-round consumption rates. In 1993, a follow-up survey was conducted by West. A total of 7,000 survey questionnaires were delivered and 2,681 were completed and returned. A response rate of 46.8 was calculated by removing those respondents who could not be located or who did not reside in Michigan for at least six months. Estimates of fish consumption were reported by minority status and income status (low income or non-low income) for both sport and commercial fish. Respondents were also surveyed on education, species targeted, and cooking methods. The survey period extended for a year, covering all four seasons. The strengths of both of these surveys are sample size and reliance on short-term recall (EPA, 1996).

Minority, low income respondents were reported to have the highest ingestion rates followed by non-minority low income respondents. The 95th percentile ingestion rates for minority, low income (109 grams/person/day) and non-minority low income (78 grams/person/day) respondents were used to represent subsistence and high end sport angler ingestion rates. Ingestion rates are normalized over a 365 day period by multiplying the number of fish meals by the serving size and dividing by 365 days/year. A typical serving size of 8 ounces is used (EPA, 1996).

USEPA has conducted a statistical validation of the West data showing strong correlation between 7 day recall ingestion rates and long term recall ingestion rates (USEPA, 1995d). The Kalamazoo River Survey may have resulted in a bias toward populations who only fished during daylight hours when the survey was conducted. The lack of interview data from Hmong anglers has been previously noted and may

present a deficiency regarding subsistence fishing patterns. Responses to questions regarding catch and release practices resulted in inconsistent responses. When asked if they practice "catch and release" only, 73.5 percent of respondents answered yes, although, a total of 44 percent also reported eating fish from the Kalamazoo River and/or Portage Creek. *The Kalamazoo River Angler Survey and Biological Testing Study* (MDCH, 1998) was conducted to determine the utilization of the affected portions of Portage Creek and the Kalamazoo River by sport anglers or other persons who regularly eat fish from these waters. Face to face interviews were conducted with 938 individuals in Kalamazoo and Allegan counties. Fish ingestion rates by age, education, race, gender, smoking and drinking status were reported. About 75 percent of anglers surveyed reported they eat fish from the river no more than one meal per month (7 grams/person/day). Slightly more than 10 percent reported eating fish more often than one meal per week (32 - 65 grams/preson/day). The mean ingestion rate for sport anglers was reported as 24 meals/year.

A second Kalamazoo River Angler Survey was conducted by Dr. Charles Atkin of Michigan State University (Atkin, 1994). The survey was conducted via long-distance telephone interviews and included 690 respondents. Interviews were conducted in six counties: Allegan, Barry, Calhoun, Eaton, Kalamazoo, and Ottawa. 33% of the study participants were from Kalamazoo and Allegan counties. While the study's applicability to this HHRA is limited by the fact that less than a dozen people from Kalamazoo County and less than 50 people from Allegan County (the two counties within the KRSS) were actually asked which fish were eaten, and questions exist regarding validity of questions, answers, or data entry, several of the conclusions of the study support the use of a number of assumptions in the HHRA:

- Those who consume fish eat an average of 2.6 meals per week, slightly higher than the 2.4 meals per week used for the sport angler (high end) in the HHRA.

- Average serving size was 8.66 ounces, higher than the 8 ounce assumption used in the HHRA.

- 6% percent of those surveyed overall indicated they eat bottom-feeding fish, lending additional support to include a representative bottom-feeder in the HHRA. Regarding consumption of bottom feeders, a slightly greater percentage of participants in Kalamazoo and Allegan counties, compared to the study group overall, indicated they consume carp, catfish, and suckers.

- 30% of those eating bottom feeding fish reported they sometimes or never remove or puncture the skin and 30% of those eating fish reported they sometimes or never trim fat from fish. This response lends additional support to evaluating risks and hazards associated with the skin-on fillet and not using a reduction factor (see Section 3.5.2.3) for trimming.

The *Great Lakes Water Quality Initiative Technical Support Document for Human Health Criteria and Values* (EPA, 1995) reports a 15 grams/person/day ingestion rate as the mean value for sport anglers in the Great Lakes Basin and as the 90th percentile for the overall population in the Basin. The value of 15 grams/person/day was derived from a review of several regional studies in Michigan, (West, 1989, 1993) Wisconsin (Fiore, et al., 1989) and New York (Connelly et al., 1990). This fish ingestion rate is used by the MDEQ Surface Water Quality Division to establish surface water quality standards. The 15 grams is divided into the grams of trophic level 3 fish consumed (3.6 grams) and the grams of trophic level 4 fish consumed (11.4 grams) as reported in the West et al. (1993) survey. This value is also consistent with the Kalamazoo River Angler Survey (MDCH, 1998) which reports a mean value for sport anglers of 24 meals/year (24 meals/year * 8 ounces/meal * 28.3 grams/ounce ÷ 1 year/365 days = 15 grams/person/day).

3.5.2.2 Species Consumed

Four species of fish were collected from the API/PC/KR during the Biota Investigation: carp, smallmouth bass, sucker and golden redhorse. Carp and smallmouth bass were targeted as representative bottom dwelling fish and sport fish. The following species were reported consumed by Kalamazoo River Angler Survey respondents: catfish (83.6 percent); bass (69 percent); panfish (63 percent); walleye (46 percent); bullheads (29.9 percent); carp (27 percent); and suckers (13 percent). West reported 0.48 percent of individuals consumed smallmouth bass and 0.07 percent consumed carp. In terms of species consumed, the West data is considered less reliable than the Kalamazoo River Survey because the waterbodies covered included fish species not found or not prevalent in the Kalamazoo River.

Two scenarios were evaluated for both sport and subsistence anglers: (1) ingestion of 100 percent smallmouth bass; and (2) ingestion of a combination of 75 percent bass and 25 percent carp based on the percentage of tropic level 3 fish (carp) and trophic level 4 fish (smallmouth bass) reported to be consumed (west, 1993). For the first scenario, exposure concentrations were based on solely smallmouth bass data collected from the site. For the second scenario, a combination of smallmouth bass and carp data were used. Total ingestion rates were apportioned across the two species accordingly. Skin-on data were used for bass and skin-off data were used for carp.

3.5.2.3 Reduction Factors

Fish advisories typically include recommendations on trimming and cooking fish that can result in a reduction in the delivered dose of a chemical. The 2000 Michigan Fish Advisory includes the following recommendations:

- Trim fatty areas (removal of the skin, belly fat, lateral and dorsal fat).
- Remove or puncture skin before cooking allowing the fat to drain off.

- Cook so fat drips away. Bake, broil, or grill on a rack, or poach and do not use the liquid.
- Deep-fry trimmed fillets in vegetable oil.
- Do not pan-fry in butter or animal fat, and do not make fish soups or chowder.

The advisory states that a reduction of 50 percent of the contaminants in fish can be eliminated by following these practices.

In *Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory* (GLFATF, 1993), the effects of trimming and cooking are discussed. Fish which contain high concentrations of lipids are likely to have higher concentrations of lipophilic chemicals, such as PCBs. Removal of the fatty portions of fish will reduce the overall delivery of PCBs. Cooking typically reduces a ½ lb raw sample to 1/3 lb cooked weight. The Protocol reports that the contaminant concentration (on a mg/kg basis) after cooking was most often the same as before cooking, though due to the reduced size of the sample, total delivered dose would be lower.

Data reported in the Kalamazoo River Angler Survey indicate that 35 percent of anglers leave the skin on fish prior to cooking. Based on data reported by ethnicity in the 1991-1992 Michigan Sport Anglers Study, between 44 and 84 percent of minority respondents reported not trimming fat from sport fish prior to cooking. Between 23 and 40 percent reported not removing skin prior to cooking. The most popular method of cooking was reported to be pan frying by 56 percent of anglers.

Based on a review of the preparation and cooking practices reported in the Kalamazoo River Angler Survey and the Michigan Anglers Survey, a cooking reduction factor of 22 percent was incorporated into the equations used to estimate risk and hazard for the high end sport angler and the subsistence angler. No additional reduction was assumed to result from trimming, given the practices reported in the angler surveys. In a study by Zabik and others (Zabik, 1995), pesticides and total PCBs were determined in raw and cooked skin-on and skin-off chinook salmon harvested from Lakes Huron and Michigan, as well as in carp fillets harvested from Lakes Erie and Huron. The effects of baking, charbroiling, and canning salmon and pan and deep fat frying carp on contaminant loss were measured. Average losses of total PCBs for carp ranged from 30 to 35 percent (Zabik, 1995). A 22 percent reduction in PCBs, expressed as micrograms per fillet in raw and pan fried skin-on carp fillets, was reported. A reduction factor of 22 percent is also consistent with the general recommendation of 30 percent for cooking losses only presented in the Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory (GLFATF, 1993).

A reduction factor was not used for the central tendency sport angler in order to be consistent with assumptions used by the MDEQ Surface Water Quality Division.

3.5.2.4 Fraction from Contaminated Source

It was assumed that high end sport anglers may frequent different locations to fish. Some of these locations may include water bodies other than the Kalamazoo River. Fifty percent of their total fish ingestion was assumed to come from the API/PC/KR site. Within the site, it is also possible to fish from different ABSAs, though average risks and hazard would not vary significantly depending on location within the site because detected fish concentrations are relatively consistent from ABSAs 3 through 11.

To be consistent with the MDEQ Surface Water Quality Division, the fraction of exposure from the API/PC/KR site was assumed to be 100 percent for the central tendency angler.

It was assumed that the subsistence angler population is more likely to fish from one area. A low-income population may not have ready access to transportion that would allow them to travel to different areas to fish. The fraction of exposure from the API/PC/KR site was assumed to be 100 percent for the subsistence angler population.

Nearby residents were assumed to receive 100 percent of their exposure to soil from the floodplain soil.

3.5.3 Exposure Point Concentrations

Average and maximum concentrations were used to reflect a range of exposure point concentrations for the angler and nearby residents scenarios. These concentrations are presented on Tables 2-1 and 2-3. An attempt was made to calculate the upper 95 percent confidence limit (95% UCL) around the mean for both the fish and floodplain data sets. In both cases, the 95 %UCL exceeded the maximum concentrations. As specified by USEPA guidance, the maximum concentration were therefore selected as the upper bound exposure point concentrations (USEPA, 1992).

3.5.4 Intake Equations

The intake or dose from the ingestion of fish is calculated using the equation presented on **Figure 3-2** (USEPA, 1989). The intake or dose from the ingestion, dermal and inhalation of floodplain soil is presented in **Figure 3-3** (MDEQ, 1995). The values for the variables in these equations were discussed in Section 3.5.2.

FIGURE 3-2
FORMULA USED FOR THE CALCULATION OF INTAKE
FISH INGESTION

$$I = \frac{C * RF * IR * FI * EF * ED}{BW * AT}$$

WHERE:

I = Intake (mg/kg-day)

C = Concentration in Raw Fish (mg/kg)

RF = Reduction Factor (unitless)

IR = Ingestion Rate (kg/day)

FI = Fraction Ingested (unitless)

EF = Exposure Frequency (days/year)

ED = Exposure Duration (years)

BW = Body Weight (kg)

AT = Averaging Time (days)

FIGURE 3-3
FORMULA USED FOR THE CALCULATION OF INTAKE
FLOODPLAIN SOILS - INGESTION / DERMAL CONTACT / INHALATION

$$I = \frac{C * FC\,(EF_i * IR_{soil} * AE_i)+(EF_d * DF * AE_d)+(EF_{inhal} * IR_{air} * AE_{inhal}\,(VF+PEF))}{AT * CF}$$

WHERE:

I	=	Intake (mg/kg-day)
C	=	Concentration in Soil (g/kg)
FC	=	Fraction of Soil Contaminated (unitless)
Ir_{soil}	=	Ingestion Rate (Soil) (mg-yr/kg-day)
DF	=	Age-adjusted Dermal Factor (mg-yr/kg-day)
IR_{air}	=	Inhalation Rate (Air) (m^3-yr/kg-day/day)
EF_i	=	Exposure Frequency (Ingestion) (days/year)
EF_d	=	Exposure Frequency (Dermal) (days/year)
EF_{inhal}	=	Exposure Frequency (Inhalation) (days/year)
AE_i	=	Absorption Efficiency (Ingestion) (unitless)
AE_d	=	Absorption Efficiency (Dermal) (unitless)
AE_{inhal}	=	Absorption Efficiency (Inhalation) (unitless)
VF	=	Soil to Air Volatilization Factor (mg/m^3-air/mg/kg-soil)
PEF	=	Particulate Emission Factor (mg/m^3-air/mg/kg-soil)
AT	=	Averaging Time (days)
CF	=	Conversion Factor (μg/kg)

Section 4
Toxicity Assessment

PCBs have been associated with both cancer and noncancer health effects. Noncancer health effects include neurotoxicity, reproductive and developmental toxicity, immune system suppression, liver damage, skin irritation, and endocrine disruption (USEPA, 1996). A toxicity profile which summarizes the carcinogenic and noncarcinogenic health effects associated with PCBs is included in Appendix E. A summary of the key studies of the human health effects of PCBs is presented herein.

4.1 Summary of Health Effects Associated with PCBs

The Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (EPA) have jointly developed a technical paper, Public Health Implications of Polychlorinated Biphenyls (PCBs) Exposure. Human health studies discussed in this paper indicate that exposure to PCBs have been linked to the following health effects:

- Reproductive function in women
- Neurobehavioral and development deficits in newborns and school-age children from in utero exposure
- Liver disease, immune function impacts, and thyroid effects
- Increased cancer risks

Several studies have demonstrated a correlation between fish consumption by mothers and developmental disorders and cognitive deficits in children. In the first of these studies, conducted by Jacobson (Jacobson et. al. 1985, 1990a, 1990b, 1996), statistically significant decreases in gestational age, birth weight, and head circumference were observed and continued to be evident 5 to 7 months after birth. Neurobehavioral deficits were observed including depressed responsiveness, impaired visual recognition, and poor short-term memory at 7 months of age, which continued to be present at 4 years of age. While recognized limitations exist in these studies, including the pooling of blood samples, which is no longer a recognized technique, more recent studies have provided confirmatory evidence of the relationship between PCB exposure and developmental effects.

In a study of prenatal exposure and neonatal behavioral assessment scale (NBAS) performance, cord blood PCBs, DDE, HCB, Mirex, lead and hair mercury levels were determined for 152 women who reported never consuming Lake Ontario fish and 141 women who reported consuming at least 40 PCB-equivalent lbs. of Lake Ontario Fish over a lifetime. PCBs were related to impaired performance on those NBAS clusters associated with fish consumption, namely, Habituation and Autonomic clusters. Results revealed significant linear relationships between the most heavily chlorinated PCBs and performance impairments 25 – 48 hours after birth. Higher prenatal PCB

exposure was also associated with nonspecific performance impairment (Stewart, et al. 2000). PCBs of lighter chlorination were unrelated to NBAS performance.

Studies in Japan and Taiwan of PCB exposure from consumption of contaminated rice oil have contributed to the evidence of an association between PCBs and neurobehavioral effects. The illnesses were originally referred to as Yusho disease in Japan and Yu-Cheng disease in Taiwan. In earlier studies (Bandiera et al., 1984; Kunita et al.; Masuda and Yoshimura 1984; Ryan et al. 1990; ATSDR 1996) co-contaminants in the rice oil, particularly chlorinated dibenzofurans (CDFs), were considered to be the primary causal agent. Recent studies, however, involving a re-examination of previous studies and newer results from a study of children born later to exposed mothers have demonstrated developmental delays associated with maternal exposure to PCBs and CDFs (Guo et al., 1995; Chao et al., 1997).

A study of Inuit women from Hudson Bay indicated an association between levels of PCBs and dichlorodiphenylethene (DDE) in breast milk and a statistically significant reduction in male birth length (Dewailley et al. 1993a). No significant differences were observed between male and female newborns for birth weight, head circumference, or thyroid-stimulating hormone.

A study of 338 infants of mothers occupationally exposed to PCBs during the manufacture of capacitors indicated a decrease in gestational age (6.6 days) and a reduction in birth weight (153 grams) at birth in infants of mothers directly exposed to PCBs (Taylor et al., 1984). A follow-up study of 405 women in this population demonstrated that serum total PCB levels in women with direct exposure to PCBs were more than four-fold higher than for women in indirect-exposure jobs. A decrease in birth weight and gestational age was found for the infants of these women (Taylor et al. 1989).

Immune system effects on persons exposed to PCBs have been reported in several studies. A significant negative correlation between weekly consumption of fish containing PCBs from the Baltic Sea and white cell count was reported (Svensson, 1994). Immune system effects were reported in Inuit infants who were believed to have received elevated levels of PCBs and dioxins from their mother's breast milk. Effects included a decline in the ratio of the CD4+ (helper) to CD8+ (cytotoxic) T-cells at ages 6 and 12 months (Dewailley et al. 1993). Infants examined from birth to 18 months who were exposed to PCBs/dioxins in the Netherlands exhibited lower monocyte and granulocyte counts and increases in the total number of T-cells and the number of cytotoxic T-cells (Weisglas-Kuperous et al. 1995). An increase in serum PCB levels was associated with a decrease in natural killer cells (Hagamar et al. 1995).

Effects on the thyroid have been reported in a study of the Dutch population. Higher CDD, CDF, and PCB levels in human milk correlated significantly with lower plasma levels of maternal total triiodothyronine and total thyroxine and higher plasma levels of thyroid-stimulating hormone in infants during the second and third month after birth (ATSDR, 1998).

Occupational studies show some increases in cancer mortality in workers exposed to PCBs. Significant excesses of cancer mortality were found for liver, gall bladder, and biliary tract cancer (Brown, 1987), however, co-exposure to other chemicals in the workplace limits the strength of the association to PCBs. Mortality from gastrointestinal tract cancer in males and hematologic neoplasms in females was reported for capacitor workers in Italy (Bertazzi, et al. 1987). Limitations in this study include a small number of cases, short exposure period, and lack of pattern or trend when data were analyzed by duration of exposure. The results of these studies have been evaluated and are considered inconclusive by the Agency for Toxic Substances and Disease Registry (ATSDR, 1996).

Evidence of an association between exposure to PCBs by capacitor workers and mortality from malignant melanoma was reported (Sinks et al., 1992). The workers were also exposed to various solvents. More deaths were observed than expected for malignant melanoma (8 observed versus 2 expected) and cancer of the brain and central nervous system (5 observed versus 2.8 expected). Limitations include a small number of cases, insufficient monitoring data, unknown contribution of exposure to solvents, and possible bias due to the healthy worker effect. The results of this study have been evaluated and are considered inconclusive by ATSDR.

A recent study of male and female capacitor workers reported mortality from all cancers was significantly below expected for hourly male workers and comparable to expected for female workers (Kimbrough et al. 1999). Limitations with this study include:

- exposed and unexposed workers were included as one group diluting any potential cancer findings;
- 76 percent of the workers never had exposure to PCBs
- only 4 percent of the workers had any PCB blood data and only 2 percent worked in jobs with high exposure to PCBs; and
- 79 percent of the workers who did die of cancer had PCB exposures less than one year

The ATSDR has stated it is untenable to dismiss concerns for carcinogenicity of PCBs. In 1999, the ATSDR convened an Expert Panel Review of the Toxicological Profile for PCBs. The panel concurred that the Kimbrough study of General Electric capacitor workers could not be used to dismiss the carcinogenic potential of PCBs (Bove, et al. 1999).

For reasons such as those above, U.S. EPA also concludes that the limitations of the Kimbrough study prevent conclusions to be drawn regarding the carcinogenicity of PCBs. While all human studies have limitations and confounders, controlled animal studies, such as a long term bioassay conducted by General Electric (Mayes, 1998) provide conclusive evidence that PCBs, including the lower chlorinated forms (i.e.

Arochlor 1016 and 1242) cause cancer. For this reason, the International Agency for Research on Cancer and the U.S. Environmental Protection Agency have concluded that the PCBs are probable human carcinogens. These conclusions are independently consistent with the National Toxicology Program's eight Report on Carcinogens, which lists PCBs as "reasonably anticipated to be human carcinogens."

A recent study demonstrated a strong dose-response relationship between total lipid-corrected serum PCB concentrations and the risk of non-Hodgkin lymphoma (Rothman et al. 1997). These findings are consistent with another study where residues of PCBs in adipose tissue of non-Hodgkin's lymphoma patients were higher than those of control patients (Hardell et al. 1996). In studies of capacitor workers, significantly increased risks were reported for lymphatic/haematological malignant (LHM) diseases among female capacitor workers but non-significant increases were found for male workers (Bertazzi et al. 1987). Two other studies found no evidence of increase in LHM among workers (Brown 1987; Sinks et al. 1992).

Health Studies in the Great Lakes Basin

Research indicates that the primary pathway of exposure to PCBs in the Great Lakes region is from fish consumption. Recent evidence indicates an association between PCB exposures through fish consumption and reproductive and developmental effects. Newborns of mothers in the high fish consumption category exhibited a greater number of abnormal reflexes, less mature autonomic responses and less attention to visual and auditory stimuli (Lonky et al. 1996).

The Lake Michigan Maternal Infant Cohort study was the first epidemiologic investigation to demonstrate an association between the self-reported amounts of Lake Michigan fish eaten by pregnant women and behavioral deficits in their newborns. The 242 infants born to mothers who had eaten the greatest amount of contaminated fish during pregnancy had (1) more abnormally weak reflexes; (2) greater motor immaturity and more startle responses; and (3) less responsiveness to stimulation (ATSDR, 1998). A follow-up examination of 212 children indicated that the neurodevelopmental deficits found during infancy and early childhood still persisted at age 11 years (Jacobsen and Jacobsen, 1996).

In a study of nervous system dysfunction in adults exposed to PCBs and other persistent toxic substances, motor slowing and attention difficulties were directly related to the frequency of consumption of St. Lawrence Lakes fish (Mergler, 1997, 1998).

In an ongoing study of Native Americans in Minnesota, Wisconsin, and Michigan preliminary results indicated elevated serum PCB levels were correlated with self-reported diabetes and liver disease (Dellinger et al, 1997; Tarvis et al. 1997; Gerstenberger et al. 1997). The average annual fish consumption rate was 23 grams per day.

In a study of the PCB congener profile in the serum of humans consuming Great Lakes fish, an established cohort of persons with robust exposure to contaminants in recreationally caught Great Lakes fish were shown to have significant quantities of serum PCBs still present 15 years after enrollment in the study. The current levels of PCBs in this group were far above those found in enrollees of more recent fish-eater studies. Identification of the PCB profile in fish-eaters and non-fisheaters revealed the presence of several congeners that have the potential to affect biologic or health outcomes. Investigators are currently in the process of evaluating neuropsychologic function and thyroid function in the Lake Michigan fish-eaters for which PCB congener profiles were established (Humphrey, et al, 2000)

The Kalamazoo River Angler Survey (MDCH, 2000b) included a second phase which included a health survey and biological testing. In this second phase, individual self-reported medical information and fish consumption patterns was obtained and chemical analyses for PCBs, DDE, and mercury was performed on blood samples of 151 out of the original 938 survey participants. The study attempted to analyze for possible associations between chemical residue levels and self-reported health problems for fisheaters and compared chemical residue data from this study cohort to other fish eating populations previously studied.

The study reported that "medical problems reported as subjective symptoms (upset stomach, nausea, headache, or dizziness) were not measurable or quantifiable in an objective way. Statistically significant associations were not found between contaminant residues levels and self-reported medical problems. However, those anglers who considered themselves to be in good health appeared to be less likely to have blood PCB levels exceed median values for the aggregate group than anglers who considered themselves to be in fair/poor health."

Significantly higher levels of PCBs were found in fisheaters compared with non-fisheaters. The geometric mean for fisheaters was 2.1 ppb PCBs in blood and for non-fisheaters was 1.11 ppb PCBs in blood. Increasing residue levels for PCBs suggested a good correlation with age reflecting the persistence of these compounds in human tissues and possible higher past exposures. In contrast to previous studies of sport anglers, the Kalamazoo River Survey appears to indicate lower exposure to PCBs. Lake Michigan open water fisheaters were first evaluated in 1979-1980 and reevaluated in 1989 (Humphrey, 1988; Hovinga et al, 1992). The Lake Michigan fisheaters consumed an annual average of 32 pounds (64 meals per year) of sport-caught fish, whereas the Kalamazoo anglers consumed an annual average of 9 pounds (18 meals per year) of sport-caught fish. The Kalamazoo fisheaters more closely resembled the nonfisheaters in the Lake Michigan study.

In a comparison of Kalamazoo anglers with a survey of anglers on Wisconsin inland lakes and rivers (Fiore, 1989), the following was observed: (1) Kalamazoo anglers ate on average less fish than the Wisconsin anglers but had higher PCB levels; (2) 59 of the Wisconsin anglers had no detectable PCBs while only 10 Kalamazoo River anglers were non-detectable; (3) the upper range of serum PCBs (73 ppb) reported in

Kalamazoo was more than two and one-half times the upper range seen in Wisconsin (27.1 ppb).

Limitations of Phase II of the Kalamazoo River Angler Survey include: (1) selection bias in that the study group was self-selected; (2) fish consumption within the past 12 months was used as the exposure variable, rather than historic consumption; (3) response bias due to participants knowing the purpose of the study; and (4) biases associated with self-reporting health effects.

4.2 Cancer Dose Response Evaluation

A recent re-evaluation of the cancer dose-response relationship for PCBs introduced a new approach for evaluating cancer risks associated with PCB exposure. This approach includes a range of cancer slope factors to be used depending on the medium of exposure and the form of the PCBs (persistent PCBs, dioxin-like congeners, and tumor-promoting congeners). Other features of this approach include:

- Upper-bound and central slope estimates, with guidance on when each is appropriate;
- A procedure for adjusting exposure duration to include internal exposure, reflecting persistence in the body;
- Incorporation of biologically-based modeling results of tumor-promotion and cell dynamics;
- Application of new principles from EPA's cancer guideline revisions (USEPA, 1994a and 1994b).

Three tiers of human slope factors for environmental PCBs have been developed by USEPA as presented in **Table 4-1**. The exposure pathways to be evaluated in the HHRA fall in the high risk and persistence category with the exception of inhalation of volatile PCBs, which is in the low risk and persistence category. The upper bound slope factor is used to quantify risks. The revised approach also recommends adding 9 years of duration to the high risk exposures and 4 years duration to the low risk exposures. This adjustment accounts for internal exposure from PCBs, which persist in the body after external exposure stops.

4.3 Noncancer Dose Response Evaluation

USEPA has developed reference doses (RfDs) with which to evaluate noncancer health effects for two Aroclors - Aroclor 1016 and 1254. Reference concentrations (RfC) have not been developed with which to evaluate inhalation exposures. The RfDs are used to evaluate ingestion, dermal and inhalation exposures. The health endpoint for Aroclor 1016 is reproductive effects. The health endpoint for Aroclor 1254 is immunotoxicity (USEPA, 1999).

Table 4-1
Range of PCB Slope Factors
Allied Paper/Portage Creek/Kalamazoo River Site

Level of Risk/Resistance	Slope Factors (mg/kg-day)$^{-1}$		Criteria for Use
High Risk and Persistence	2.0	1.0	Food chain experiences Sediment or soil ingestion Dust or aerosol inhalation Dermal exposure (if absorption factor) Dioxin-like, tumor-promoting, or persistent congeners Early life exposures
Low Risk	0.4	0.3	Water ingestion Inhalation of Volatile PCBs Dermal exposure (if no absorption factor)
Lowest Risk and Persistence	0.07	0.04	Congeners with more than 4 chlorines comprise less than 0.5% of total PCBs

Aroclor 1248 is a prevalent contaminant at the site. USEPA has not developed an RfD (or other toxicity values) for Aroclor 1248 because a serious health effect, or Frank Effect, (death of an offspring) was observed at the lowest dose level received by Rhesus monkeys. In general, Rhesus monkeys have shown adverse effects to PCB mixtures at doses 10-fold lower than in other species. As stated in the Integrated Risk Information System (IRIS) file, USEPA considers these data inadequate for the derivation of an oral RfD and the chemical is classified as "Non Verifiable". The secondary source of toxicity values, the Health Effects Assessment Summary Tables (USEPA, 1997) does not provide an RfD for Aroclor 1248.

In the absence of an RfD for Aroclor 1248, the RfD for Aroclor 1254 has been used to assess risks associated with exposure to Aroclor 1248. Studies conducted on both mixtures used Rhesus monkeys. The lowest dose administered in the Aroclor 1248 study was 0.03 mg/kg-day. The lowest dose administered in the Aroclor 1254 study was 0.005 mg/kg-day. Observed health effects at the lowest dose in the Aroclor 1254 study included various immunologic functions. These effects are considered appropriate to determine the "lowest observed adverse effects levels" (LOAELS), as opposed to the Frank Effect observed in the Aroclor 1248 study at the higher dose. The RfDs used to evaluate noncancer health effects are presented in **Table 4-2.**

Table 4-2
Non-Cancer Toxicity Date - Oral/Dermal/Inhalation
API/PC/KR Site

Chemical of Potential Concern	Chronic/Subchronic	Oral RfD Value	Oral RfD Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (1) (MM/DD/YY)
Aroclor 1254	Chronic	2.0E-05	mg/kg-day	immune system - decreased antibody (IgG and IgM) response to sheep erythrocytes	300 / 1	IRIS	03/08/00
Aroclor 1016	Chronic	7.0E-05	mg/kg-day	reproductive effects - reduced birth weights	100 / 1	IRIS	03/08/00

(1) For IRIS values, provide the date IRIS was searched.
For Heast values, provide the date of HEAST
For NCEA values, provide the date of the article provided by NCEA.

Section 5
Risk Characterization

Risk characterization is the final step in the risk assessment process. In this step, toxicity information is combined with estimates of dose to yield quantitative estimates of cancer risk and noncancer hazard.

5.1 Overview of Noncarcinogenic Hazard Characterization

Non-carcinogenic hazard is measured in terms of a Hazard Quotient (HQ). The HQ is defined by the equation:

HQ = ADD/RfD

where:

HQ = Hazard Quotient associated with the exposure via the specified exposure route (unitless)

ADD = Average Daily Dose (in mg/kg/day)

RfD = Reference Dose (in mg/kg/day)

or, for inhalation exposures:

HQ = [OHM]air/RfC

where:

[OHM]air = exposure point concentration of the oil or hazardous material in air (in µg/m3)

RfC = Reference Concentration or substitute toxicity value for chemical (in µg/m3)

In evaluating the hazard quotient, it is assumed that the potential toxicities of individual chemicals within a mixture are additive. Thus, HQs and cancer risks attributable to each chemical are summed for each receptor to obtain a cumulative hazard index (HI).

A cumulative HI represents the cumulative noncarcinogenic impact that the site has on a particular receptor group. The cumulative HI accounts for exposures that a receptor may receive from multiple chemicals and multiple exposure routes:

Total HIroute-specific = Σ HQchemical-specific

Cumulative HI = Σ HIroute-specific

The HQ is a unitless ratio of a receptor's exposure level (or dose) to the "acceptable" (or allowable) exposure level. A Hazard Index of 1.0 or less for exposure via all chemicals and routes indicates that the receptor's exposure is equal to or less than the allowable exposure level, and it is considered unlikely that adverse health effects will occur. When the cumulative HI is less than or equal to 1.0, a conclusion of "no significant risk of harm to human health" based on noncancer effects, is appropriate. Both the MDEQ and USEPA have hazard index thresholds of 1.0.

5.2 Overview of Cancer Risk Characterization

For potential carcinogens, cancer risks are obtained by the following equation:

$$\text{Risk} = \text{LADD} \times \text{CSF}$$

where:

Risk = Excess Lifetime Cancer Risk associated with exposure to the chemical via the specified route of exposure
LADD = Lifetime Average Daily Dose (in mg/kg/day)
CSF = Cancer Slope Factor (in [mg/kg/day]-1)

In evaluating the potential cancer risks, it is assumed that potential toxicity of chemical mixtures is additive.

Risk is a unitless probability of an excess cancer rate due to contamination from the site. The MDEQ has established a regulatory cancer risk threshold of 1 in 100,000 excess lifetime cancer risks. The USEPA Superfund program uses 1 in 1 million as the point at which risk management decisions may be considered. Risks between 1 in 1 million and 1 in 10,000 are generally acceptable and risks outside of this range (greater risks) typically require risk management.

5.3 Estimation of Noncarcinogenic Hazard and Carcinogenic Risk

Estimated hazard quotients and cancer risks for each of the seven study areas and three floodplain soil areas are presented in **Figures 5-1 through 5-12** and **Tables 5-1 through 5-6.** The figures present only the hazard indices for the immunological endpoint, which were higher than those for the reproductive endpoint. Hazard indices for both endpoints are presented in the Tables. Separate estimates are presented for the following scenarios:

- Subsistence anglers consuming 100 percent smallmouth bass (average concentrations)
- Subsistence anglers consuming 100 percent smallmouth bass (maximum concentrations)

Figure 5-1
Cancer Risks for Study Areas Based on Average Concentrations
API/PC/KR Site

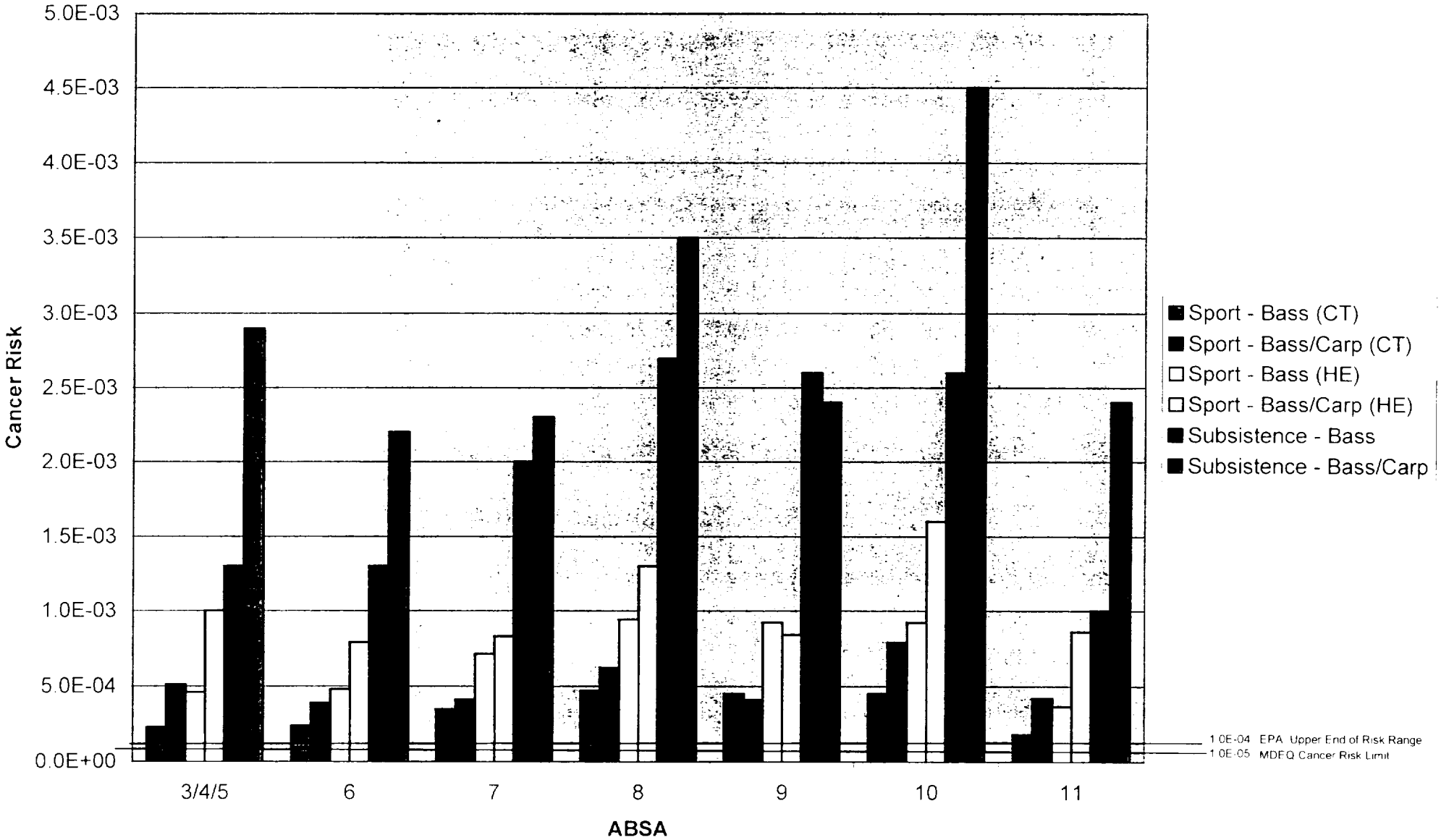


Figure 5-2
Cancer Risks for Study Areas Based on Maximum Concentrations
API/PC/KR Site

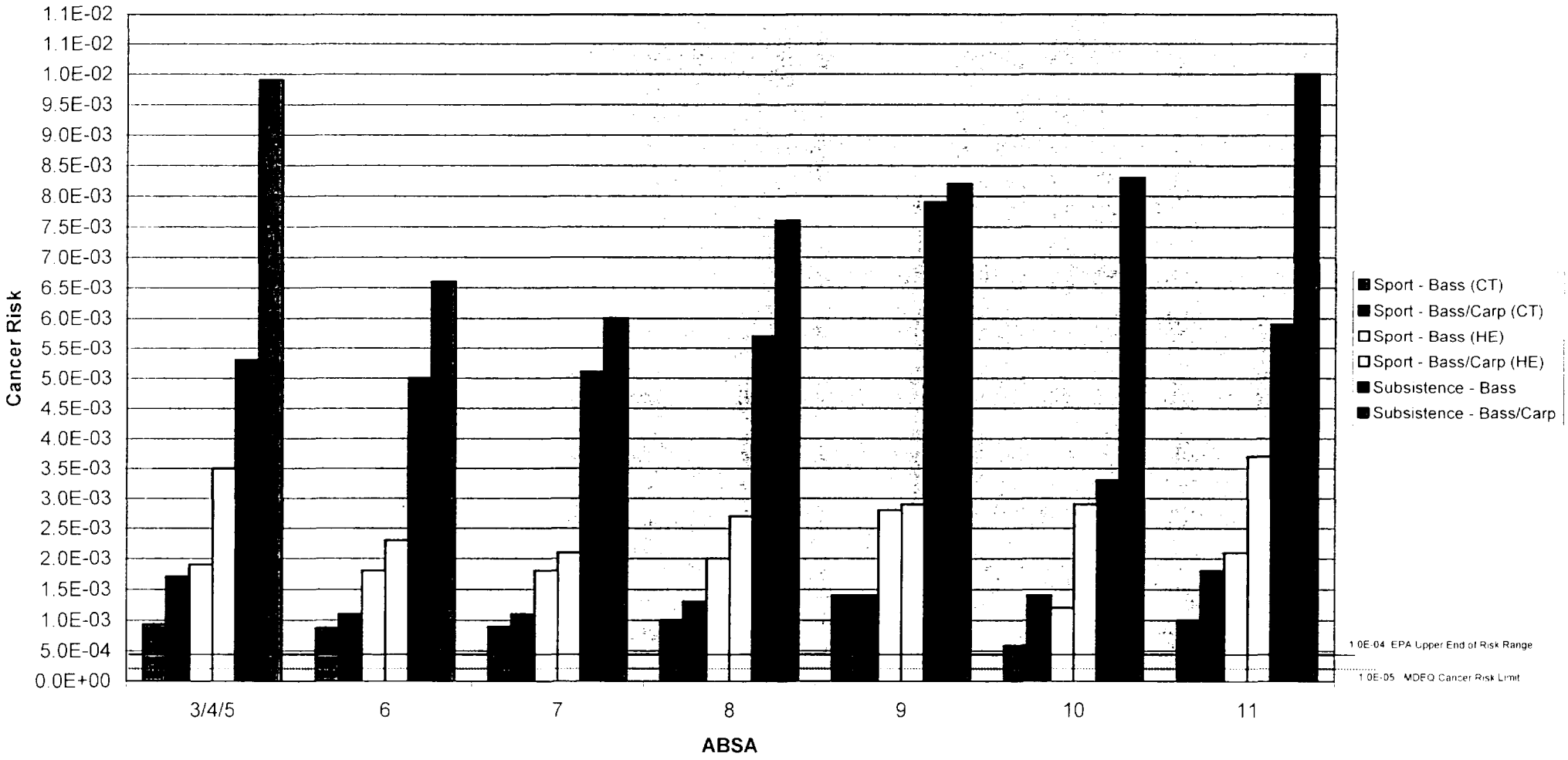


Figure 5-3
Hazard Quotients for Study Areas Based on Average Concentrations
Immunological Endpoint
API/PC/KR Site

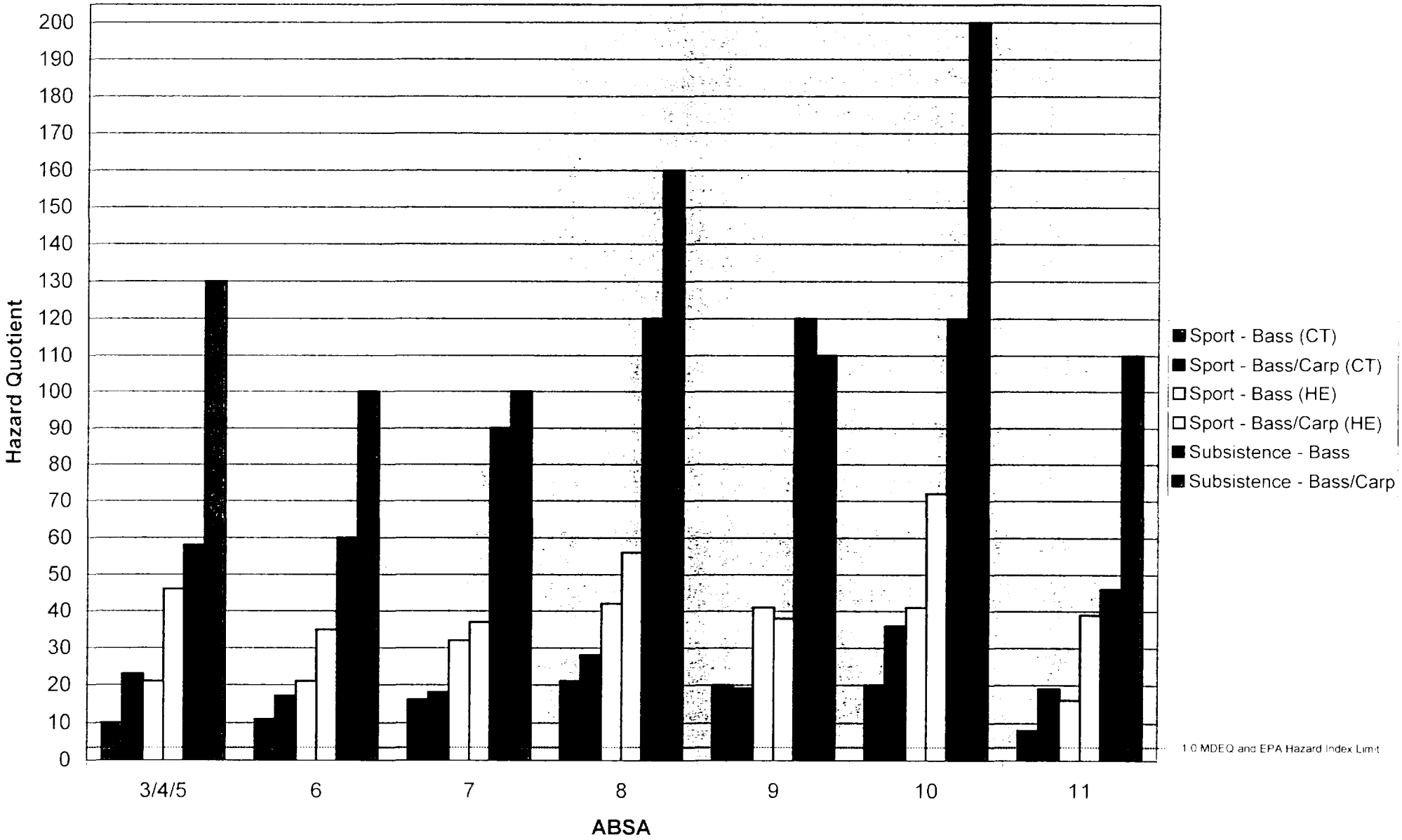


Figure 5-4
Hazard Quotients for Study Areas Based on Average Concentrations
Reproductive Endpoint
API/PC/KR Site

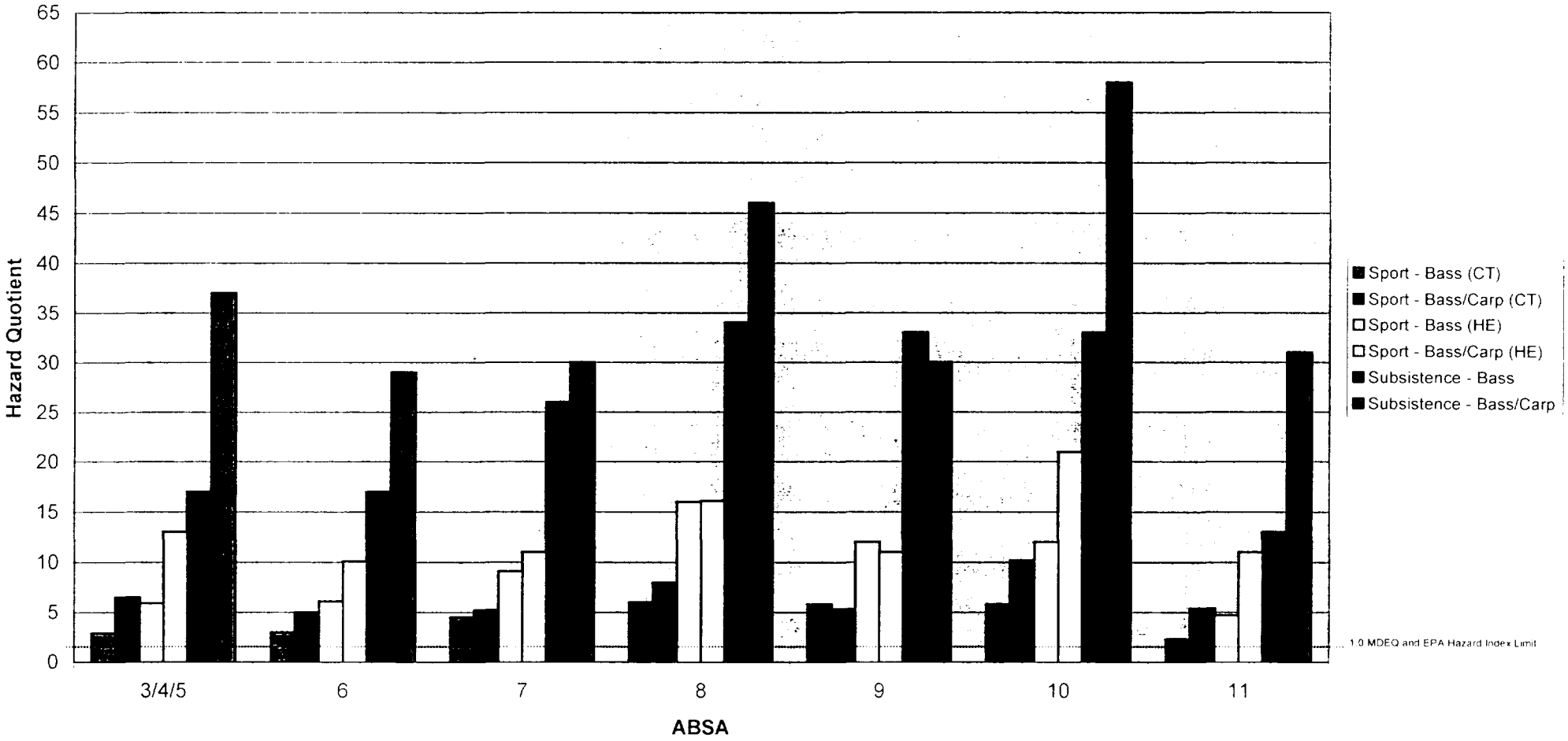


Figure 5-5
Hazard Quotients for Study Areas Based on Maximum Concentrations
Immunological Endpoint
API/PC/KR Site

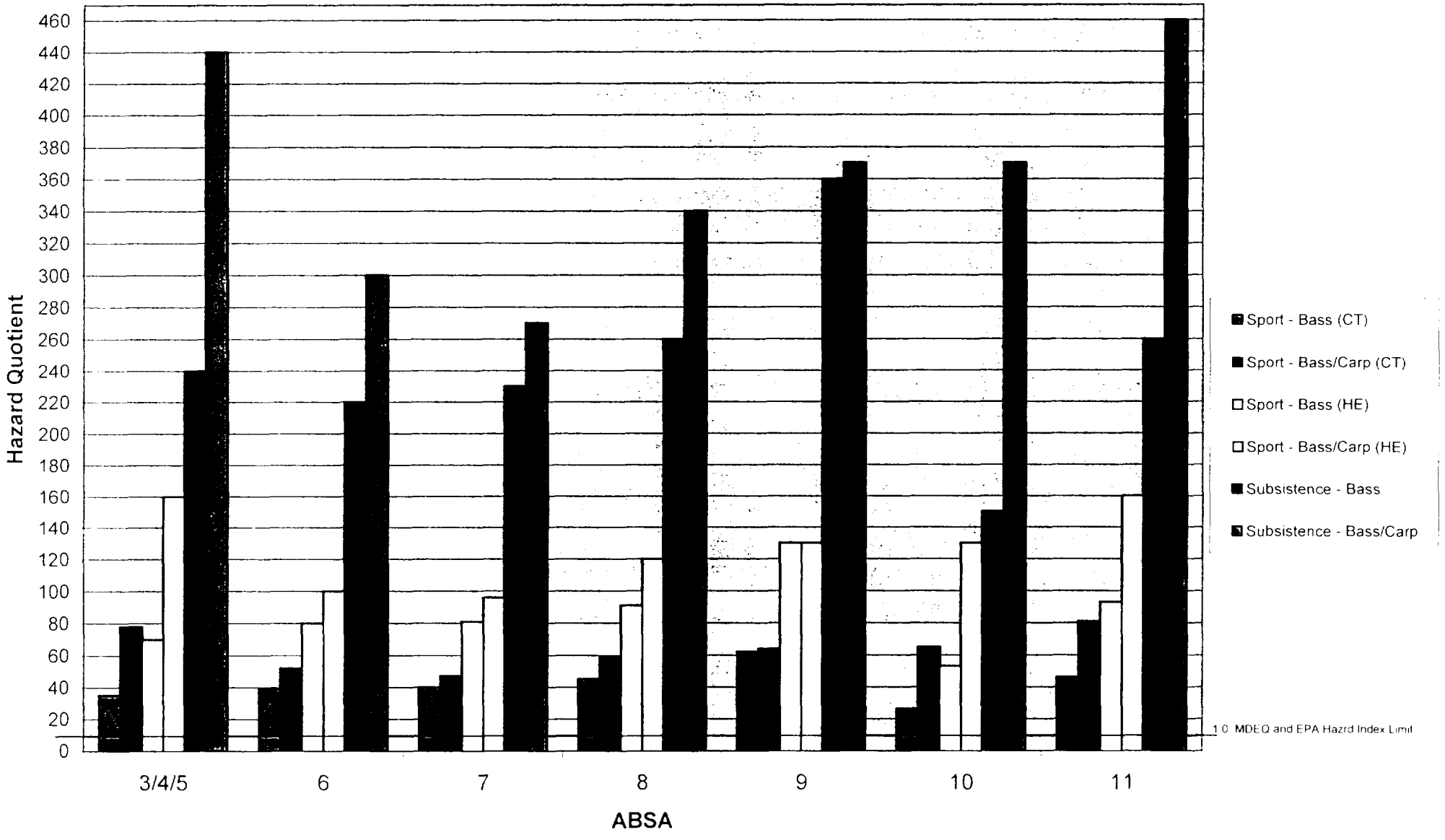


Figure 5-6
Hazard Quotients for Study Areas Based on Maximum Concentrations
Reproductive Endpoint
API/PC/KR Site

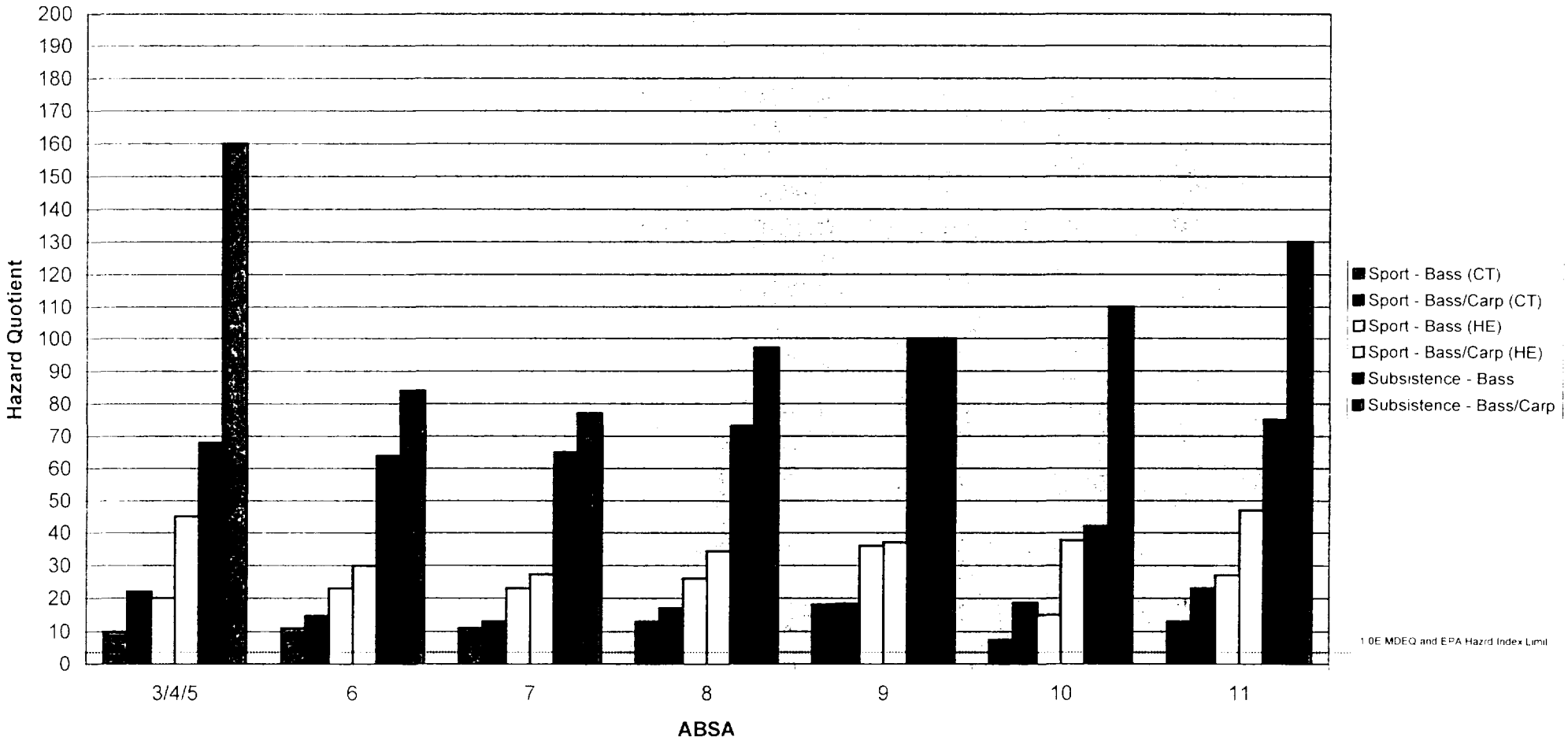


Figure 5-7
Cancer Risks to Residents: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations

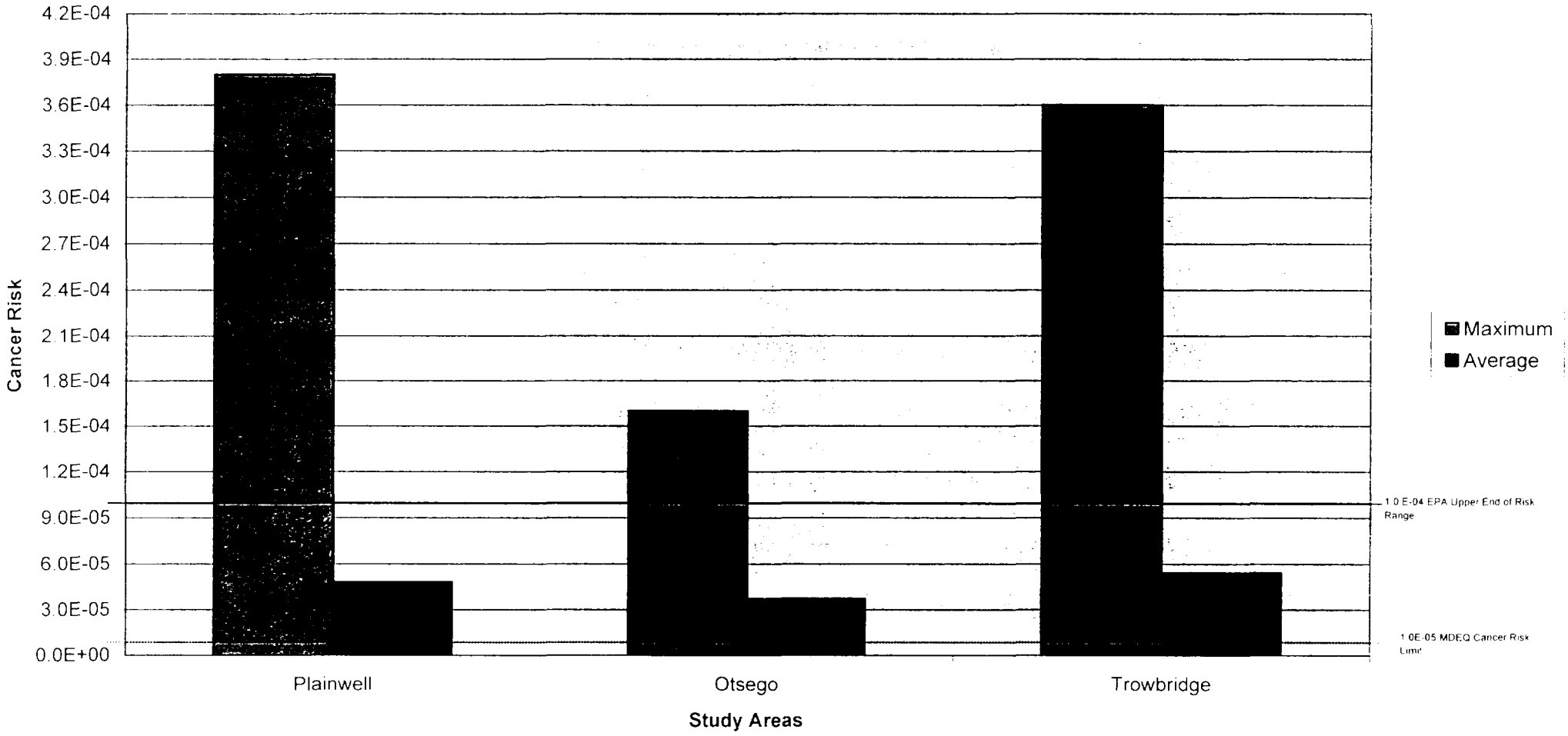


Figure 5-8
Hazard Quotients for Residents: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations
Immunological Endpoints

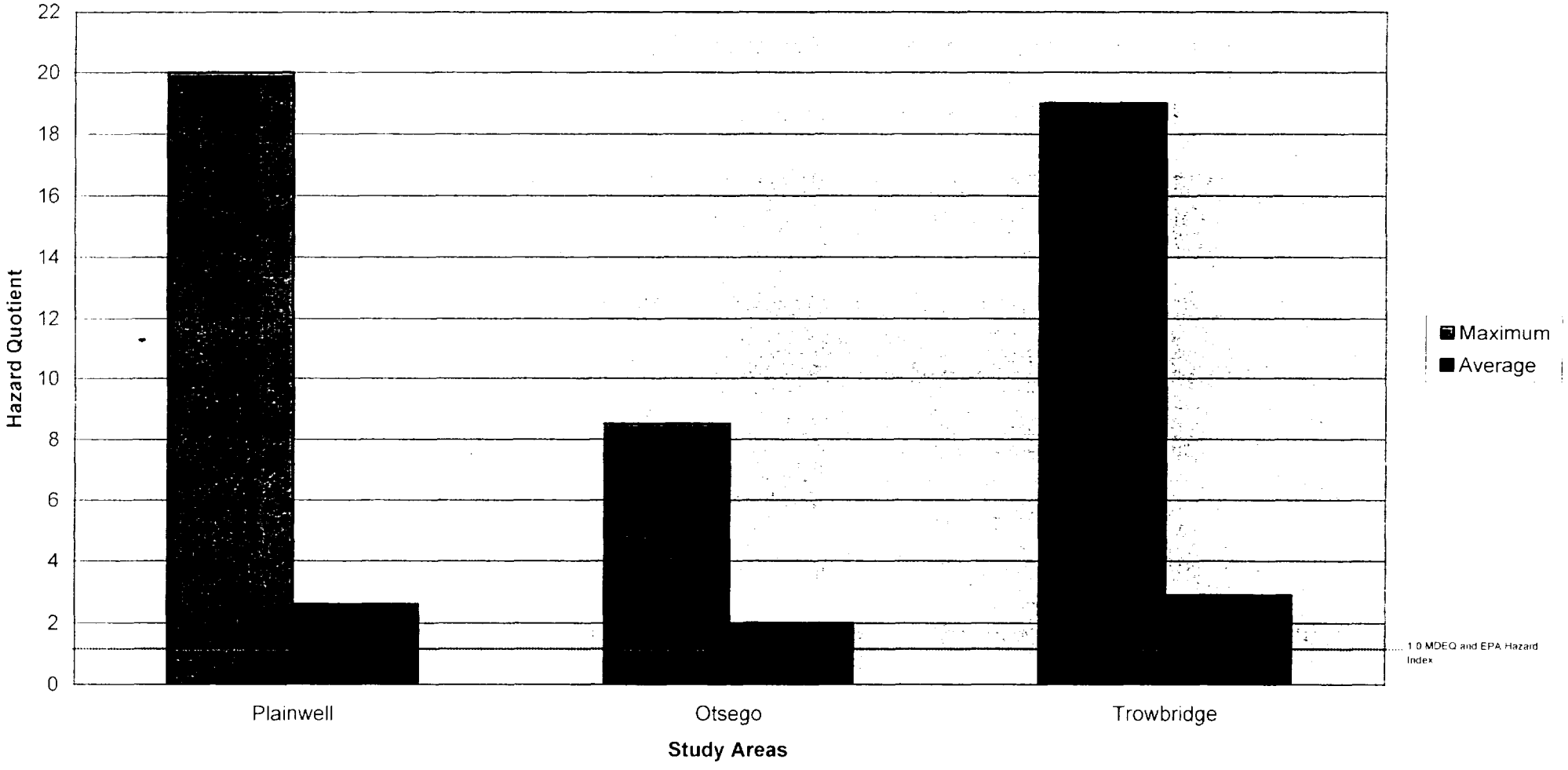


Figure 5-9
Hazard Quotients for Residents: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations
Reproductive Endpoint

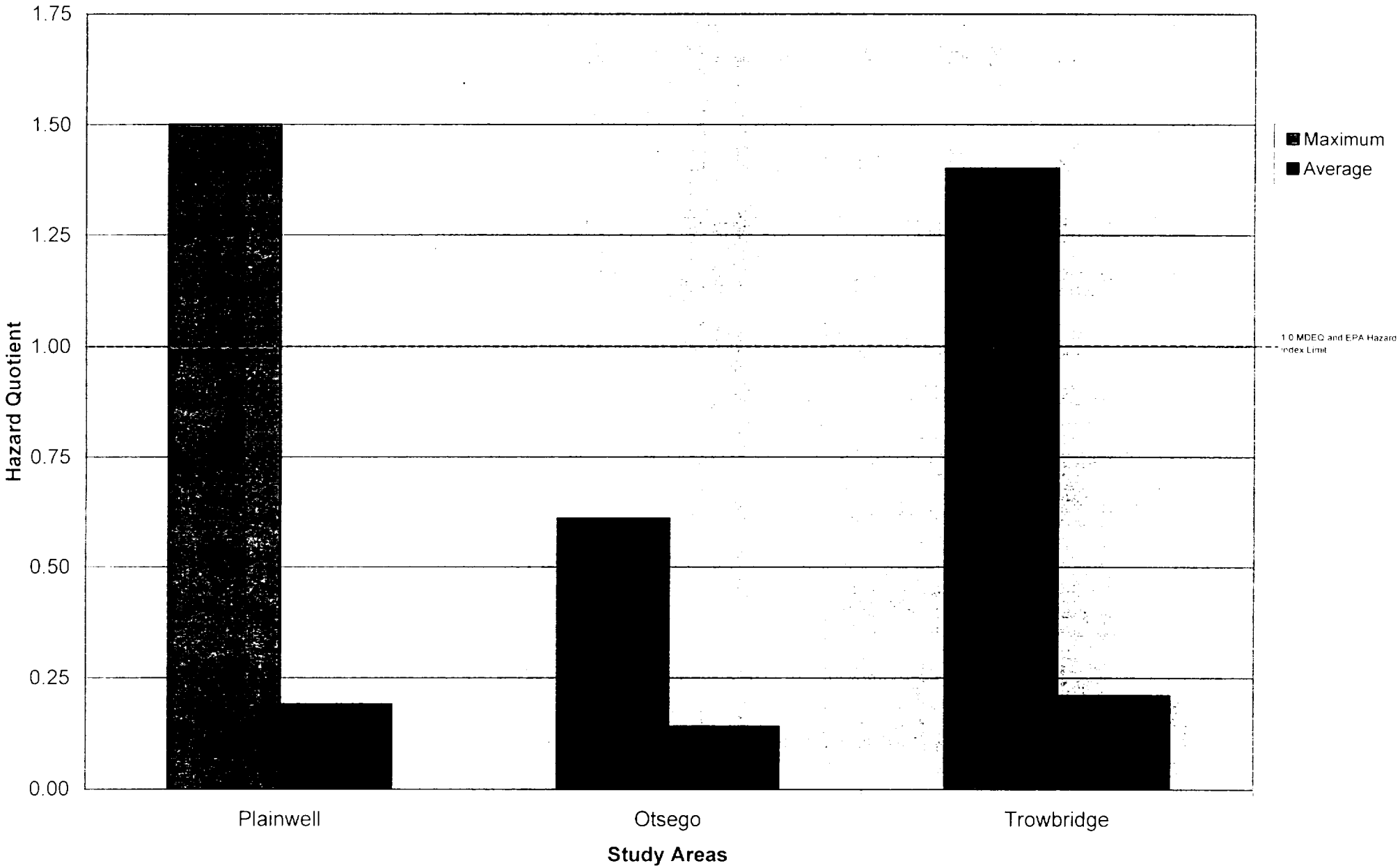


Figure 5-10
Cancer Risks to Recreationalists: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations

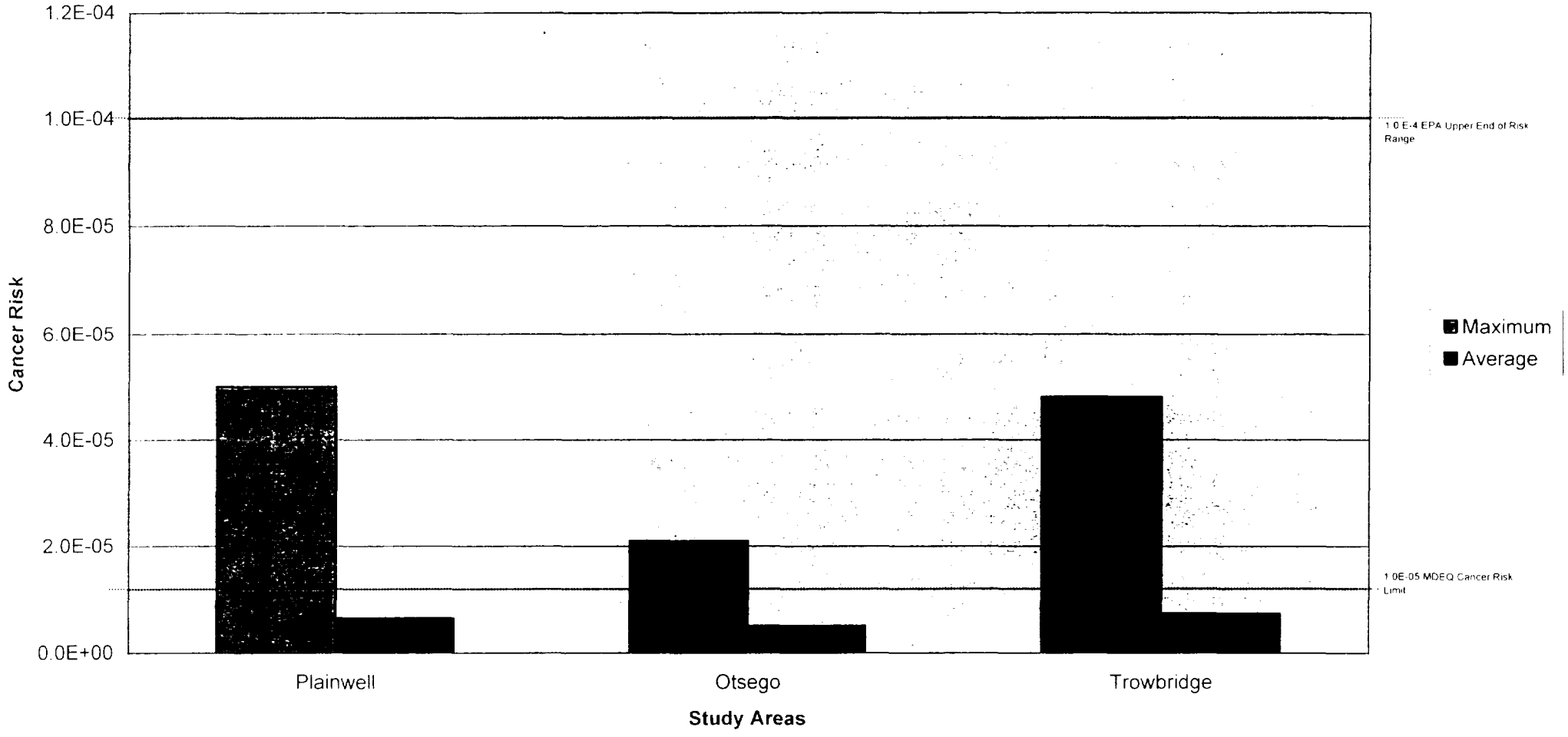


Figure 5-11
Hazard Quotients for Recreationalists: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations
Immunological Endpoints

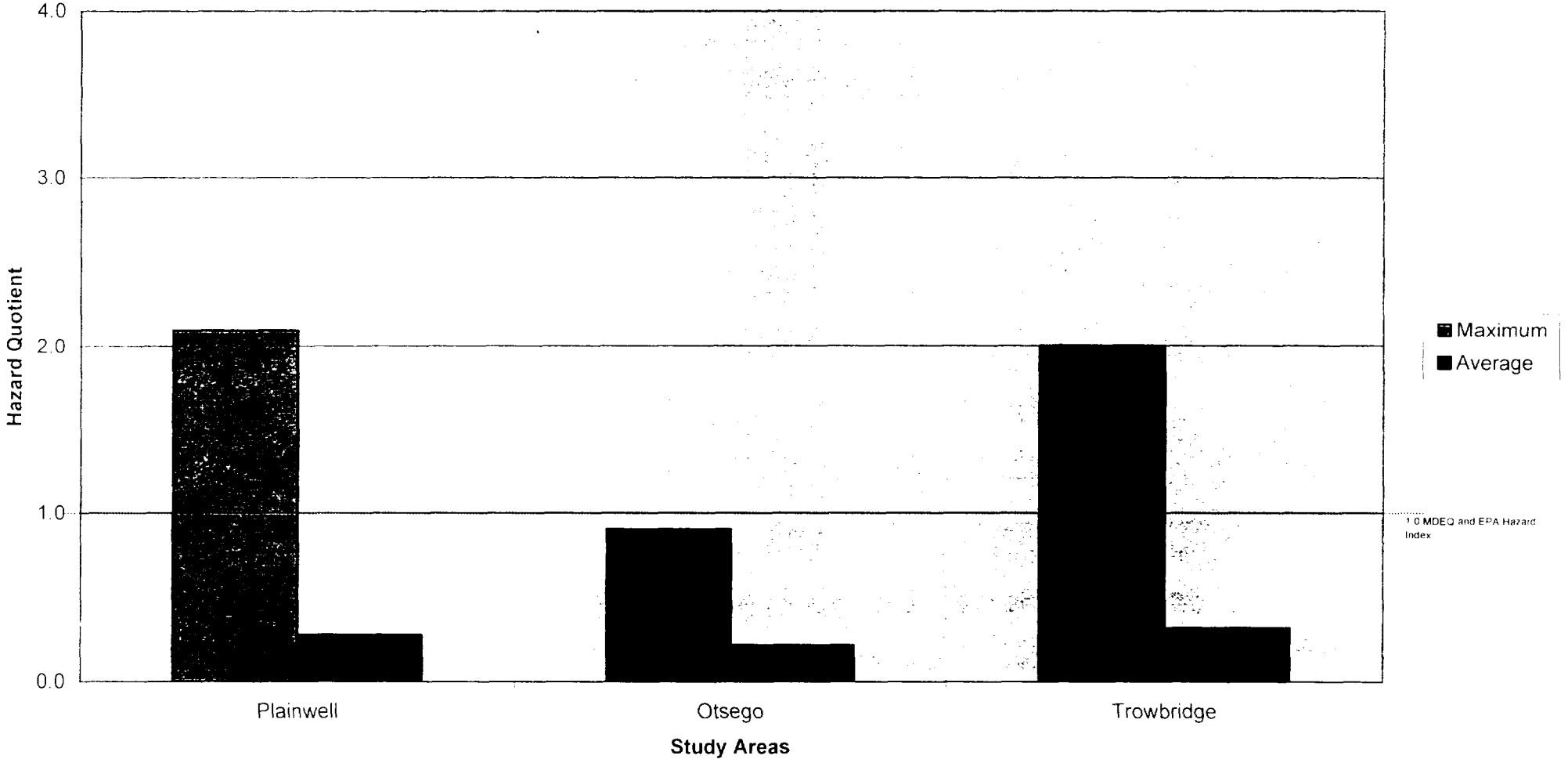


Figure 5-12
Hazard Quotients for Recreationalists: Plainwell, Otsego, and Trowbridge Impoundments
Based on Maximum and Average Concentrations
Reproductive Endpoint

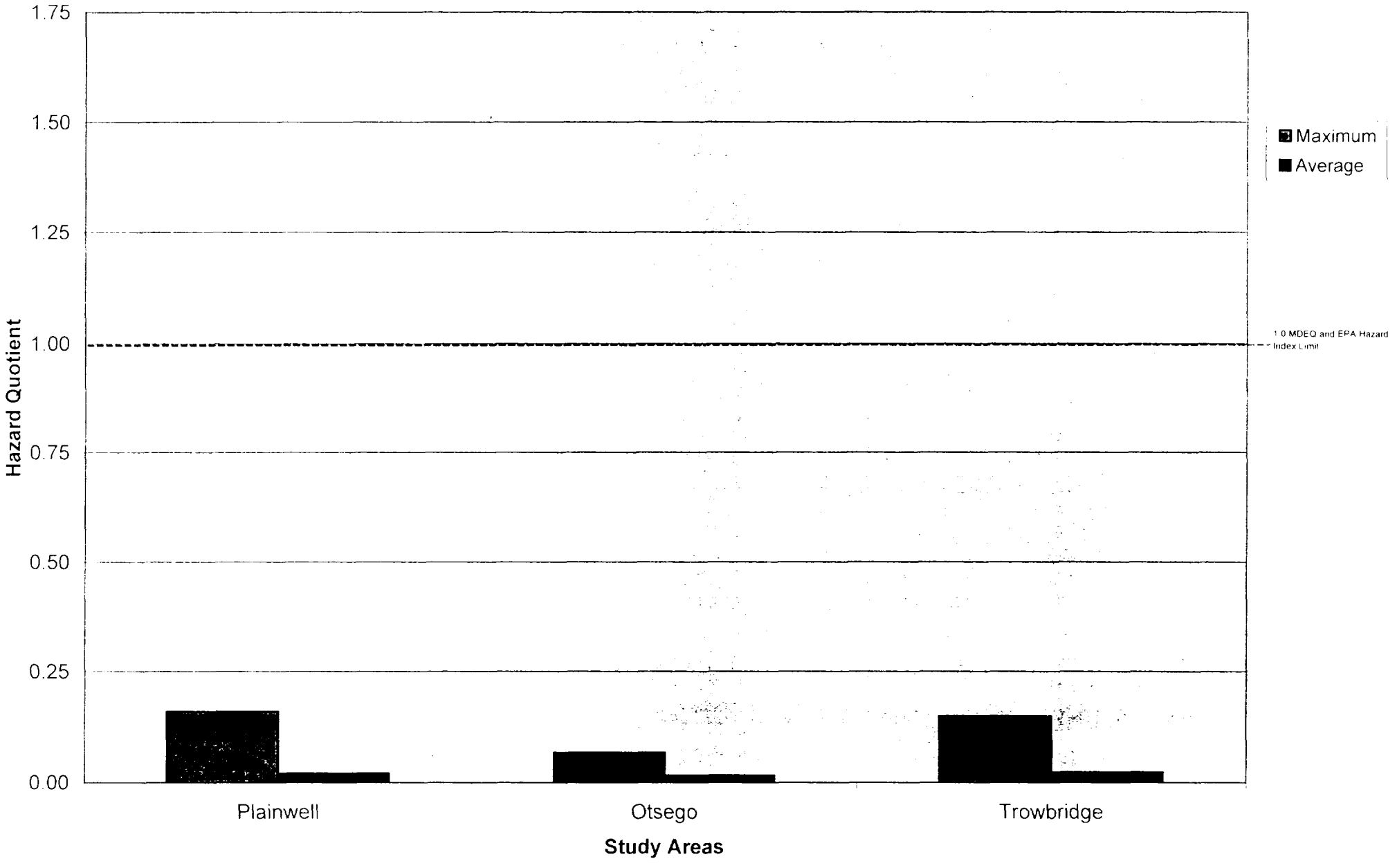


TABLE 5-1
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
AVERAGE CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	1.3E-03	2.9E-03	2.3E-04	5.1E-04	4.6E-04	1.0E-03
		ABSA 6	Total PCBs	1.3E-03	2.2E-03	2.4E-04	3.9E-04	4.8E-04	7.9E-04
		ABSA 7	Total PCBs	2.0E-03	2.3E-03	3.5E-04	4.1E-04	7.1E-04	8.3E-04
		ABSA 8	Total PCBs	2.7E-03	3.5E-03	4.7E-04	6.2E-04	9.4E-04	1.3E-03
		ABSA 9	Total PCBs	2.6E-03	2.4E-03	4.5E-04	4.1E-04	9.2E-04	8.4E-04
		ABSA 10	Total PCBs	2.6E-03	4.5E-03	4.5E-04	7.9E-04	9.2E-04	1.6E-03
		ABSA 11	Total PCBs	1.0E-03	2.4E-03	1.8E-04	4.2E-04	3.7E-04	8.6E-04

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)

TABLE 5-1(Continued)
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
AVERAGE CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient from Ingestion of Fish					
				Subsistence		Sport-Central Tendency		Sport-High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	17 (R) 58 (I)	37 (R) 130 (I)	2.9 (R) 10 (I)	6.5 (R) 23 (I)	5.9 (R) 21 (I)	13 (R) 46 (I)
		ABSA 6		17 (R) 60 (I)	29 (R) 100 (I)	3.0 (R) 11 (I)	4.9 (R) 17 (I)	6.1 (R) 21 (I)	10 (R) 35 (I)
		ABSA 7		26 (R) 90 (I)	30 (R) 100 (I)	4.5 (R) 16 (I)	5.2 (R) 18 (I)	9.1 (R) 32 (I)	11 (R) 37 (I)
		ABSA 8		34 (R) 120 (I)	46 (R) 160 (I)	6.0 (R) 21 (R)	7.9 (R) 28 (I)	16 (R) 42 (I)	16 (R) 56 (I)
		ABSA 9		33 (R) 120(I)	30 (R) 110 (I)	5.8 (R) 20 (I)	5.3 (R) 19 (I)	12 (R) 41 (I)	11 (R) 38 (I)
		ABSA 10		33 (R) 120 (I)	58 (R) 200 (I)	5.8 (R) 20 (I)	10 (R) 36 (I)	12 (R) 41 (I)	21 (R) 72 (I)
		ABSA 11		13 (R) 46 (I)	31 (R) 110 (I)	2.3 (R) 8.1 (I)	5.4 (R) 19 (I)	4.7 (R) 16 (I)	11 (R) 39 (I)

Notes: Target hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE 5-2
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CAR	100% SMB	75% SMB / 25% CAR	100% SMB	75% SMB / 25% CAR
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	5.3E-03	9.9E-03	9.3E-04	1.7E-04	1.9E-03	3.5E-03
		ABSA 6	Total PCBs	5.0E-03	6.6E-03	8.7E-04	1.1E-03	1.8E-03	2.3E-03
		ABSA 7	Total PCBs	5.1E-03	6.0E-03	8.9E-04	1.1E-03	1.8E-03	2.1E-03
		ABSA 8	Total PCBs	5.7E-03	7.6E-03	1.0E-03	1.3E-03	2.0E-03	2.7E-03
		ABSA 9	Total PCBs	7.9E-03	8.2E-03	1.4E-03	1.4E-03	2.8E-03	2.9E-03
		ABSA 10	Total PCBs	3.3E-03	8.3E-03	5.8E-04	1.4E-03	1.2E-03	2.9E-03
		ABSA 11	Total PCBs	5.9E-03	1.0E-02	1.0E-03	1.8E-03	2.1E-03	3.7E-03

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)

TABLE 5-2 (Continued)
SUMMARY OF RISKS AND HAZARDS FOR SUBSISTENCE AND SPORT ANGLERS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Non-Carcinogenic Hazard Quotient from Ingestion of Fish					
				Subsistence		Sport – Central Tendency		Sport – High End	
				100% SMB	75% SMB / 25% CARP	100% SMB	75% SMB/ 25% CAR	100% SMB	75% SMB / 25% CARP
Fish	Fish	ABSA 3,4,5 (Combined)	Total PCBs	68 (R) 240 (I)	160 (R) 440 (I)	9.9 (R) 35 (I)	22 (R) 78 (I)	20 (R) 70 (I)	45 (R) 160 (I)
		ABSA 6	Total PCBs	64 (R) 220 (I)	84 (R) 300 (I)	11 (R) 38 (I)	14 (R) 52 (I)	23 (R) 80 (I)	29 (R) 100 (I)
		ABSA 7	Total PCBs	65 (R) 230 (I)	77 (R) 270 (I)	11 (R) 40 (I)	14 (R) 47 (I)	23 (R) 81 (I)	27 (R) 94 (I)
		ABSA 8	Total PCBs	73 (R) 260 (I)	97 (R) 340 (I)	13 (R) 45 (I)	17 (R) 59 (I)	26 (R) 91 (I)	34 (R) 120 (I)
		ABSA 9	Total PCBs	100(R) 360 (I)	100 (R) 370 (I)	18 (R) 62 (I)	18 (R) 64 (I)	36 (R) 130 (I)	37 (R) 130 (I)
		ABSA 10	Total PCBs	42 (R) 150 (I)	110 (R) 370 (I)	7.4 (R) 26 (I)	19 (R) 65 (I)	15 (R) 53 (I)	37 (R) 130 (I)
		ABSA 11	Total PCBs	75 (R) 260 (I)	130 (R) 460 (I)	13 (R) 46 (I)	23 (R) 81 (I)	27 (R) 93 (I)	47 (R) 160 (I)

Notes: Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE 5-3
SUMMARY OF RISKS AND HAZARDS FOR RESIDENTS
LIVING NEAR EXPOSED FLOODPLAIN SOILS
AVERAGE CONCENTRATIONS
API/K/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk Exposure Routes Total	Chemical	Non-Carcinogenic Hazard Quotient Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	5.4E-05	Total PCBs	0.21 (R) 2.9 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	3.7E-05	Total PCBs	0.14 (R) 2.0 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	4.8E-05	Total PCBs	0.19 (R) 2.6 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE 5-4
SUMMARY OF RISKS AND HAZARDS
FOR RESIDENTS LIVING NEAR EXPOSED FLOODPLAIN SOILS
MAXIMUM CONCENTRATIONS
API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk	Chemical	Non-Carcinogenic Hazard Quotient
				Exposure Routes Total [1]		Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	3.6E-04	Total PCBs	1.4 (R) 19 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	1.6E-04	Total PCBs	0.61 (R) 8.5 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	3.8E-04	Total PCBs	1.5 (R) 20 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)
(R): Reproductive endpoint
(I): Immunological endpoint

TABLE 5-5
SUMMARY OF RISKS AND HAZARDS FOR RECREATIONAL VISITORS TO EXPOSED
FLOODPLAIN SOILS AVERAGE CONCENTRATIONS
API/K/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk Exposure Routes Total [1]	Chemical	Non-Carcinogenic Hazard Quotient Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	7.3E-06	Total PCBs	0.023 (R) 0.31 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	5.0E-06	Total PCBs	0.016 (R) 0.21 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	6.4E-06	Total PCBs	0.021 (R) 0.27 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)

TABLE 5-6
SUMMARY OF RISKS AND HAZARDS FOR RECREATIONAL VISITORS TO EXPOSED FLOODPLAIN SOILS MAXIMUM CONCENTRATIONS API/KC/KR SITE

Source Medium	Exposure Medium	Exposure Point	Chemical	Carcinogenic Risk	Chemical	Non-Carcinogenic Hazard Quotient
				Exposure Routes Total [1]		Exposure Routes Total
Floodplain Soils	Floodplain Soils	Trowbridge	Total PCBs	4.8E-05	Total PCBs	0.15 (R) 2.0 (I)
Floodplain Soils	Floodplain Soils	Otsego	Total PCBs	2.1E-05	Total PCBs	0.068 (R) 0.9 (I)
Floodplain Soils	Floodplain Soils	Plainwell	Total PCBs	5.0E-05	Total PCBs	0.16 (R) 2.1 (I)

Notes: Target cancer risk range: 1E-06 to 1E-04 (USEPA); 1E-05 (MDEQ)
Acceptable hazard index: 1.0 (USEPA and MDEQ)

- Subsistence anglers consuming 75 percent smallmouth bass, and 25 percent carp (average concentrations)
- Subsistence anglers consuming 75 percent smallmouth bass and 25 percent carp (maximum concentrations)
- Central tendency sport anglers consuming 100 percent smallmouth bass (average concentrations)
- Central tendency sport anglers consuming 100 percent smallmouth bass (maximum concentrations)
- Central tendency sport anglers consuming 75 percent smallmouth bass and 25 percent carp (average concentrations)
- Central tendency sport anglers consuming 75 percent smallmouth bass and 25 percent carp (maximum concentrations)
- High end sport anglers consuming 100 percent smallmouth bass (average concentrations)
- High end sport anglers consuming 100 percent smallmouth bass (maximum concentrations)
- High end sport anglers consuming 75 percent smallmouth bass and 25 percent carp (average concentrations)
- High end sport anglers consuming 75 percent smallmouth bass and 25 percent carp (maximum concentrations)
- Residents and recreationalists living near Trowbridge Dam floodplain soils (average concentrations)
- Residents and recreationalists living near Trowbridge Dam floodplain soils (maximum concentrations)
- Residents and recreationalists living near Plainwell Dam floodplain soils (average concentrations)
- Residents and recreationalists living near Plainwell Dam floodplain soils (maximum concentrations)
- Residents and recreationalists living near Ostego Dam floodplain soils (average concentrations)
- Residents and recreationalists living near Ostego Dam floodplain soils (maximum concentrations)

5.3.1 Subsistence Anglers

5.3.1.1 Cancer Risks

As presented on Tables 5-1 and 5-2 and Figures 5-1 and 5-2, cancer risks to subsistence anglers who ingested either 100 percent smallmouth bass or 75 percent smallmouth bass and 25 percent carp exceeded MDEQ and USEPA cancer risk thresholds for both average exposure point concentrations (EPCs) and maximum EPCs scenarios for all ABSAs. Cancer risks using both average and maximum EPCs were in the range of 1 in 1,000 for all study areas except ABSA 11 where cancer risks to subsistence anglers using maximum concentrations for the mixed species scenario were estimated in the range of 1 in 100. The highest cancer risks for the single species scenario was in ABSA 9 where cancer risks using maximum concentrations were estimated as 7.9 in 1,000.

5.3.1.2 Noncancer Hazard

Noncancer hazards to subsistence anglers were estimated for both reproductive and immunological effects. As presented in Tables 5-1 and 5-2 and Figures 5-3 through 5-6, hazard quotients for both endpoints for all scenarios using both average and maximum EPCs exceed the regulatory hazard index threshold of 1.0 for all ABSAs.

The hazard quotient for the average exposure point scenario ranged between 13 and 34 for the reproductive endpoint and 46 and 120 for the immunological endpoint for single species ingestion. For mixed species ingestion, the hazard quotient ranged from 29 to 58 for the reproductive endpoint and from 100 to 200 for the immunological endpoint.

The hazard quotient for the maximum exposure point scenario ranged between 42 and 100 for the reproductive endpoint and 150 and 360 for the immunological endpoint for single species. For mixed species, the hazard quotient ranged from 77 to 160 for the reproductive endpoint and from 270 to 460 for the immunological endpoint.

5.3.2 Sport Anglers - Central Tendency

5.3.2.2 Cancer Risks

As presented on Tables 5-1 and 5-2 and Figures 5-1 and 5-2, cancer risks to central tendency sport anglers exceeded both the USEPA and MDEQ cancer risk thresholds for both the average and maximum EPCs scenarios for both single and multiple species for all ABSAs. For the single species scenario using average EPCs cancer risks were all in the 1 in 10,000 range. For the single species scenario, cancer risks using maximum EPCs ranged from 5.8 in 10,000 to 1.4 in 1,000. For the multiple species scenario using average EPCs cancer risks were all in the 1 in 10,000 range. For the multiple species scenario using maximum EPCs, cancer risks were all in the 1 in 1,000 range., except for ABSA 3,4,5 where risks were 1.7 in 10,000.

5.3.2.2 Noncancer Hazard

As presented on Tables 5-1 and 5-2 and Figures 5-3 through 5-6, all scenarios using both average and maximum EPCs exceeded a hazard quotient of 1.0 for both the immunological and reproductive endpoints. The hazard quotient for the average

exposure point scenario ranged between 2.9 and 6.0 for reproductive endpoint and 8.1 and 21 for the immunological endpoint for single species. For mixed species, the hazard quotient ranged between 4.9 and 7.9 for the reproductive endpoint and 17 and 36 for the immunological endpoint.

The hazard quotient for the maximum exposure point scenario ranged between 7.4 and 18 for the reproductive endpoint and 26 and 62 for the immunological endpoint for single species. For mixed species, the hazard quotient ranged between 14 and 23 for the reproductive endpoint and 47 and 81 for the immunological endpoint.

5.3.3 Sport Anglers - High End

5.3.3.1 Cancer Risk

As presented on Tables 5-1 and 5-2 and Figures 5-1 and 5-2, cancer risks to high end sport anglers exceeded both the USEPA and MDEQ cancer risk thresholds for all ABSAs for both the average EPC and maximum EPC scenarios for both single and multiple species. Cancer risks to high end sport anglers ingesting single species were all in the 1 in 10,000 range for average EPCs and 1 in 1,000 using maximum EPCs. Cancer risks to sport anglers ingesting multiple species were in the 1 in 10,000 to 1 in 1,000 range using average EPCs and 1 in 1,000 using maximum EPCs. The highest cancer risk for high end anglers ingesting single species were estimated for ABSA 8 using average EPCs and in ABSA 9 using maximum EPCs with estimated risks of 9.4 in 10,000 and 2.8 in 1,000, respectively. For multiple species ingestion, the highest cancer risks were estimated for ABSA 10 using average EPCs and in ABSA 11 using maximum EPCs with estimated risks of 1.6 in 1,000 and 3.7 in 1,000, respectively.

5.3.3.2 Noncancer Hazard

As presented in Tables 5-1 and 5-2 and Figures 5-3 through 5-6, scenarios exceeded a hazard quotient of 1.0 for both the immunological and reproductive endpoints. The hazard quotient for the average EPC scenario ranged from 4.7 to 16 for the reproductive endpoint and 16 to 42 for the immunological endpoint for single species ingestion. For mixed species, the hazard quotient ranged between 10 and 21 for the reproductive endpoint and 35 and 72 for the immunological endpoint for multiple species.

The hazard quotient for the maximum EPC scenario ranged from 15 to 36 for the reproductive endpoint and from 53 to 130 for the reproductive endpoint. For mixed species, the hazard quotient for the reproductive endpoint ranged from 27 to 47 and for the immunological endpoint ranged from 94 to 160.

5.3.4 Nearby Residents

5.3.4.1 Cancer Risk

As presented on Tables 5-3 and 5-4 and Figure 5-7, cancer risks for nearby residents in all three floodplain soil areas were in the 1 in 100,000 range using average EPCs and in the 1 in 10,000 range using maximum EPCs. Estimates using maximum EPCs exceeded both the MDEQ and USEPA cancer risk thresholds; estimates using average EPCs exceeded the MDEQ thresholds but were within the USEPA target cancer risk

range. The highest risks using average EPCs were estimated for the Trowbridge area at 5.4 in 100,000; the highest risks using maximum EPCs were estimated for the Plainwell area at 3.8 in 10,000.

5.3.4.2 Noncancer Hazard

As presented on Tables 5-3and 5-4 and Figures 5-8 and 5-9 noncancer hazard quotients for the immunological endpoint in all three areas exceeded 1.0 using average and maximum EPCs. Hazard quotients using average EPCs ranged from 2.0 to 2.9 for the immunological endpoint and 0.14 to 0.21 for the reproductive endpoint. Estimates using maximum EPCs ranged from 8.5 to 20 for the immunological endpoint and from 0.61 to 1.5 for the reproductive endpoint.

5.3.5. Recreationalists

5.3.5.1 Cancer Risks

As presented on Tables 5-5 and 5-6 and Figure 5-10, cancer risks for recreationalists in all three floodplain areas were in the 1 in 1 million range using average concentrations and in the 1 in 100,000 range using maximum concentrations. Estimates using average concentrations were within the USEPA target risk range and below the MDEQ threshold. Estimates using maximum concentrations were within the USEPA target risk range and exceeded the MDEQ threshold. The highest risks using average concentrations were estimated for the Trowbridge area at 7.3 in 1 million. The highest risk using the maximum concentrations were estimated for the Plainwell area at 5.0 in 100,000.

5.3.5.2 Noncancer Hazard

As presented on Tables 5-5 and 5-6 and Figures 5-11 and 5-12, using average EPCs, noncancer hazard quotients for both the immunological and reproductive endpoints were below the USEPA and MDEQ threshold of 1.0. Using maximum EPCs, hazard quotients for the reproductive endpoint were all below the threshold of 1.0. Using maximum EPCs, hazard quotients for the immunological exceeded the threshold of 1.0 for Plainwell (2.1) and Trowbridge (2.0) areas. For the Otsego area, the hazard quotient was 0.9.

5.4 Summary

Risks and hazard indices for the API/PC/KR site can be summarized as follows:

- Cancer risks and hazard quotients in both central tendency and high end sport and subsistence anglers exceed MDEQ and USEPA risk limits for all scenarios in all ABSAs.

- Cancer risks for residents living near the floodplain soil behind the three MDNR impoundments exceed MDEQ thresholds using both average and maximum EPCs.

- Cancer risks for residents living near the floodplain soils behind the three MDNR impoundments are within the USEPA target cancer risk range for the average scenario.

- Cancer risks for residents living near the floodplain soils behind the three MDNR impoundments are outside the USEPA target cancer risk range using maximum EPCs.

- Hazard quotients for residents living near the floodplain soils behind the three MDNR impoundments exceed the MDEQ and USEPA threshold of 1.0 for the immunological endpoint using both average and maximum EPCs. Hazard quotients for the reproductive endpoint do not exceed a hazard quotient of 1.0 using average EPCs. Hazard quotients using maximum EPCs exceed the MDEQ and USEPA threshold of 1.0 for the Trowbridge (1.4) and Plainwell (1.5) areas, but not for the Otsego area (0.61).

- Cancer risks for recreationalists on the floodplain soil behind the three MDNR impoundments are within the USEPA target risk range and less than the MDEQ threshold using average EPCs.

- Cancer risks for recreationists on the floodplain soil behind the three MDNR impoundments are within the USEPA target risk range and exceed the MDEQ threshold using maximum EPCs.

- Hazard quotients for recreationalists on the floodplain soil behind the three MDNR impoundments are less than the USEPA and MDEQ threshold of 1.0 for both the reproductive and immunological endpoints using average concentrations.

- Hazard quotients for recreationalists on the floodplain soil behind the three MDNR impoundments are less than the USEPA and MDEQ threshold of 1.0 for the reproductive endpoint using maximum EPCs. Hazard quotients for the immunological endpoint exceeded the threshold of 1.0 for the Trowbridge (2.0) and Plainwell (2.1) areas using maximum EPCs and the hazard quotient for the immunological endpoint for the Otsego area was 0.9.

Section 6
Uncertainty Assessment

Uncertainties can arise from several sources in a human health risk assessment including data collection and interpretation, the assumptions used to characterize exposures, and the toxicity values. To compensate for uncertainty surrounding input variables, conservative assumptions are often made which tend to overestimate rather than underestimate risk. In cases where data are limited, assumptions may be based on professional judgement or subjective estimates which may under or over estimate risks.

Types of Uncertainty

There are three primary sources of uncertainty:

- Scenario uncertainty;
- Parameter uncertainty; and
- Model uncertainty

Scenario uncertainty results from missing or incomplete information needed to fully define exposure and dose. This may include errors in site information, professional judgement, assumptions regarding exposed populations, and steady-state conditions. Sources of parameter uncertainty include measurement and sampling errors, inherent variability in environmental and exposure-related parameters, the use of generic surrogate data when site-specific data are not available. Parameter uncertainty often leads to model uncertainty. One source of modeling uncertainty is relationship errors, such as errors in correlations between chemical properties. Errors due to the use of mathematical or conceptual models as simplified representations of reality are also sources of modeling uncertainty.

In general, uncertainty in exposure and associated risk estimates is attributable to the lack of, or incomplete knowledge about the correct value for a specific variable. Variability, such as individual variability or seasonal influences, also may confound exposure and risk estimates.

These three types of uncertainty have been identifies in each of the four parts of this risk assessment: data evaluation, toxicity assessment, exposure assessment, and risk characterization. Uncertainty within each of these components are discussed below.

Data Evaluation

Uncertainty is present in the data before it is even evaluated for risk assessment. This includes potential sampling bias and errors in the laboratory extraction and analysis, and the protocol employed to assess contaminants identified as non-detected. However, a higher level of confidence is placed on the analytical results because a data validation procedure has been conducted.

Fish data used to assess risks were collected in 1993 and 1997 and exposed floodplain data were collected in 1994. Because one of the primary sources of PCBs to the River is erosion of material from the riverbanks, and this source is ongoing, it is expected that levels of PCBs detected in aquatic biota have not significantly declined in the intervening period. Based on the persistence of PCBs, and in the absence of any removal action, it is not expected that significant chemical degradation has occurred in the floodplain soil. For these reasons, the data used to characterize the risk and hazards associated with ingestion of fish and contact with floodplain soil are deemed appropriate. The use of these data is unlikely to have resulted in a significant underestimation or overestimation of risks and hazards.

Data for two media were deemed inadequate to conduct a quantitative risk evaluation. Turtle consumption is a confirmed exposure pathway for the Kalamazoo River, however, turtle consumption is expected to be less than fish consumption for the majority of people. The risks and hazards associated with fish ingestion provide a conservative estimate of the risks and hazards associated with turtle consumption. The absence of quantified risks and hazards resulting from turtle ingestion likely results in an underestimation of total site risks and hazards.

Air data have not been collected in the immediate vicinity of the River or exposed floodplain areas. Data collected from the Willow Boulevard/A-Site operable unit are not representative of the conditions in the immediate vicinity of the floodplain where soils are unvegetated and prone to entrainment. Concentrations of volatile emissions and particulates above the floodplain soil have been estimated using a simplified model and risks and hazards associated with this pathway were quantified. In the absence of actual air data, it cannot be determined whether risks and hazards are underestimated or overestimated. Air quality above the surface water has not been characterized. Inhalation of volatile emissions above surface water was found to be associated with significant risks for the Lower Fox River Site (ThermoRetec, 1999). In the absence of actual data and quantitative estimates of risk and hazard for this pathway, total site risks and hazards are likely underestimated.

These data were used to verify that exposures to surface water would not result in significant risks or hazards. More recent data indicate surface water quality data reported in Technical Memorandum 16 - Surface Water Investigation (BB&L) were compared to data collected from the Lower Fox River.

Dose-Response Assessment

The dose-response section involves the estimation of the toxicological effects of a compound on humans usually based upon laboratory animal studies. A potentially significant source of uncertainty occurs when dose-response relationships in humans are derived from animal to human extrapolation. These associates often result from high-dose to low-dose extrapolations as well. Health effects criteria are derived with margins of safety relative to the degree of uncertainty in the value.

Non-cancer toxicity values and cancer slope factors have been derived from studies of commercial mixtures. After release into the environment, PCB mixtures change over time so their composition differs from commercial mixtures. Through partitioning, different fractions of the original mixture appear in the air, water, sediment, soil and biota due to different rates of volatilization, solubility, and adsorption for the congeners. (USEPA, 1996). Bioaccumulation through the food chain tends to concentrate congeners of higher chlorine content, producing residues that are considerably different from the original Aroclors (Cogliano, 1998). Both humans and animals retain persistent congeners that are resistant to metabolism and elimination (Oliver and Niimi, 1988). Mink fed Great Lakes fish contaminated with PCBs showed liver and reproductive toxicity comparable to mink fed Aroclor 1254 at quantities three times greater (Hornshaw, 1983). PCBs tested in the laboratory were not subject to prior selective retention of persistent congeners through the food chain. For exposures through the food chain, risks are higher than those estimated using toxicity values and cancer slope factors based on commercial mixtures (USEPA, 1996). Risk and hazard estimates for the fish ingestion pathway are very likely underestimated.

Exposure Assessment

The exposure assessment step involves many assumptions about "typical people" and "typical exposure scenarios" to arrive at an average daily dose. For example, a body weight of 70 kg is used for residents and anglers. Body weight ranges for each individual, so these assumptions likely over-or underestimate the true dose that people are likely to receive.

Many exposure factors were chosen to err on the side of protectiveness for human health. Exposure duration, frequency, and time were set at reasonable maximum exposure values. They likely overestimate the exposures that typically occur.

The computation of the exposure point concentration for chemicals in a number of media may have resulted in an overestimate or underestimate of risks and hazard. For chemical data sets with less than 10 samples, the maximum detected concentration was used as the exposure point concentration, as directed by the EPA. In addition, when the 95% UCL on the mean was unrealistically high (greater than the maximum detected concentration), the maximum was used as the exposure point concentration, in accordance with EPA, 1992, Supplemental Guidance to RAGS. Use of the average exposure point concentration may underestimate risks and hazards for some receptors while use of the maximum exposure point concentration may overestimate risks and hazard for some receptors.

Another assumption made in this assessment is that exposure to study chemicals in various media remain constant over time. This suggests there is a non-diminishing source of contamination and that concentrations will remain at present levels for up to 30 years. In reality, soil, sediment, surface and groundwater migrate. This would produce an exposure significantly less than that calculated in this assessment.

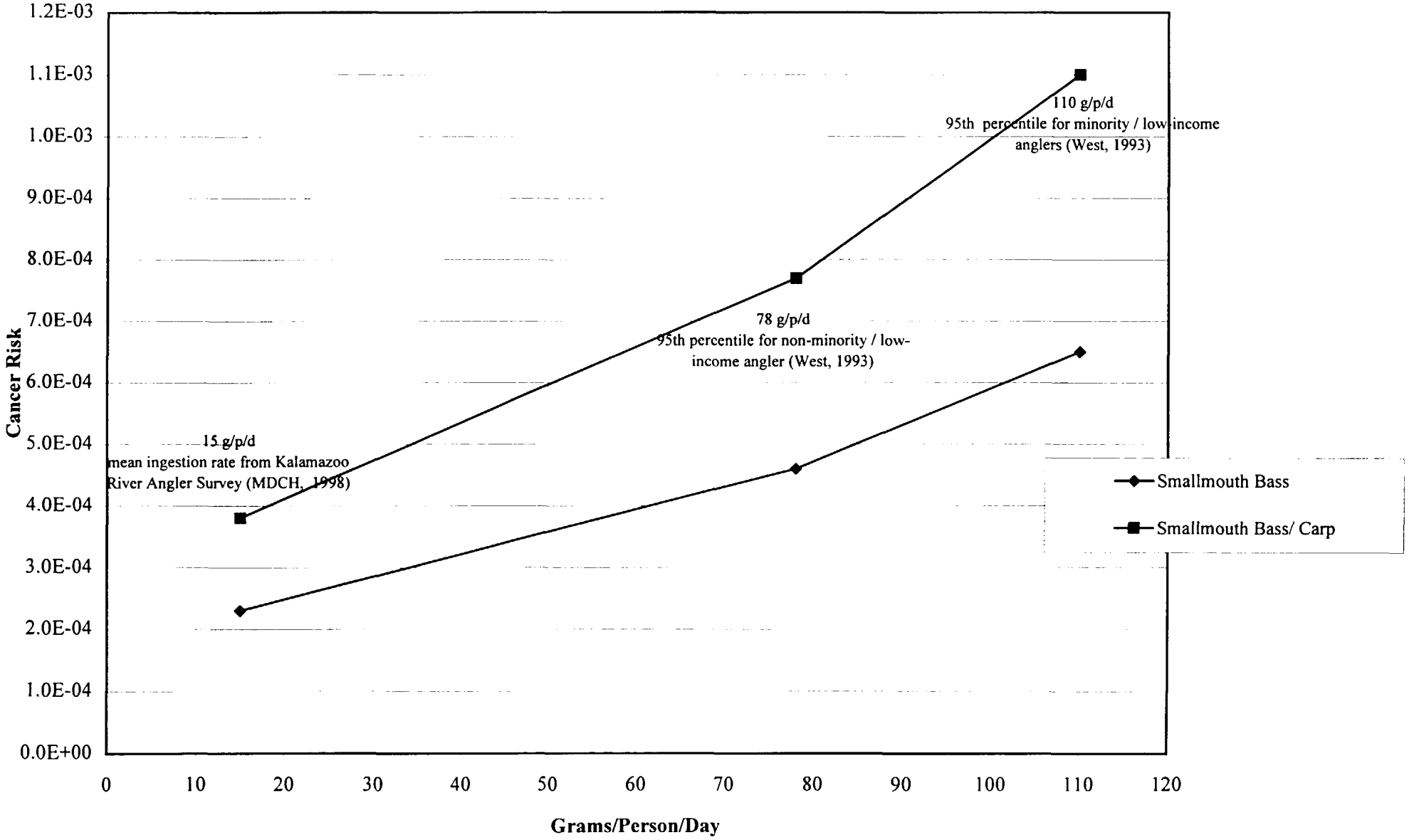
The exposure assumption with the greatest influence on risk and hazard is the fish ingestion rate. Three ingestion rates were chosen to reflect the central tendency sport angler, the high end sport angler and cancer risk estimates and hazard index estimates. The lowest ingestion rate of 15 grams/person/day, which was used to characterize risks and hazards to the central tendency sport angler, was derived from the Great Lakes Water Quality Initiative Technical Support Document for Human Health Criteria and Values (USEPA, 1995b). This ingestion rate is consistent with the mean ingestion rate for anglers reported in both the Kalamazoo River Angler Survey (MDCH, 1998) and Fish Consumption Estimates Based on the 1991-1992 Michigan Sport Anglers Fish Consumption Survey (USEPA, 1995c). A significant number of anglers ingest greater quantities of fish, therefore, the central tendency estimates under-represent risks and hazards to these individuals. Fish consumption advisories are intended to reduce the ingestion of contaminated fish. If fish consumption advisories are reducing consumption, reported consumption levels will be suppressed from their normal levels (West, 1993). Of a total of 1347 respondents to the Michigan sport Anglers consumption study, 46.8% reported to have eaten less fish in response to advisory warnings. In the Kalamazoo River Anglers Survey, 25% of respondents indicated they would make more trips to the River and fewer to other locations if the River was cleaned up to the point that fish advisories were removed; 15% of respondents indicated they would increase fishing in the Kalamazoo River without reducing trips to other bodies of water. This consumption suppression effect can result in an underestimate of risks and hazards under baseline conditions, i.e., in the absence of remediation or risk reduction measures such as fish advisories.

Figures 6-1 and 6-2 present the impacts of fish ingestion on cancer risk estimates and hazard index estimates. All three scenarios result in risks and hazards which exceed MDEQ and EPA thresholds. (NOTE: The relationship between fish ingestion rates and risks and hazard are not linear because the central tendency scenario also assumed 100 percent of ingested fish are caught at the site and there is no reduction in PCB concentrations attributable to cooking or trimming fish.)

The second most influential assumption for the fish ingestion scenario is the portion of fish caught from the contaminated source. For central tendency high end sport anglers and subsistence anglers it was assumed that all of the fish ingested came from a particular ABSA. For high end sport anglers it was assumed half of the fish ingested came from a particular ABSA. Risks and hazards are underestimated for those high end or subsistence anglers who catch all of their fish from different locations within the PI/PC/KR site.

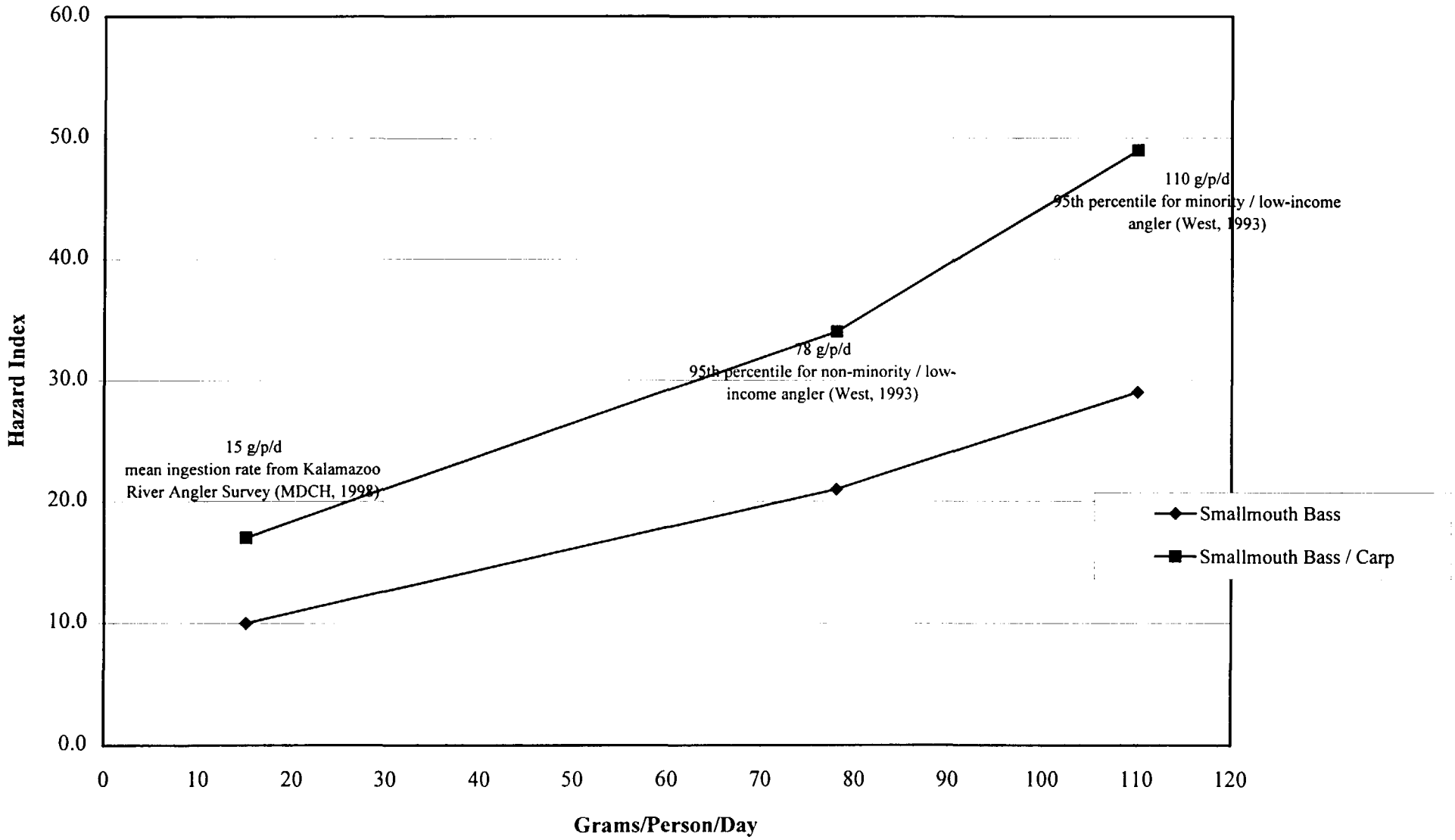
A reduction factor was used to account for the loss of PCBs when fish is cooked. A reduction factor was not used to account for PCB losses during trimming fish and removing fat. This decision is consistent with data reported in the Kalamazoo River Anglers Survey whereby 35 percent of reported leaving the skin on prior to cooking.

Figure 6-1
Impact of Fish Ingestion Rate on Cancer Risk Estimate
(Based on ABSA 6 Average Fish Concentrations)
API/PC/KR Site



USEPA target risk range: 1E-06 to1E-04
MDEQ risk threshold: 1E-05

Figure 6-2
Impact of Fish Ingestion Rate on Hazard Index Estimates
(Based on ABSA 6 Average Fish Concentrations)
API/PC/KR Site



USEPA and MDEQ Hazard Index threshold: 1.0

The Michigan Sport Anglers Study also reported that between 44 and 84 percent of anglers did not trim the fat from sport fish prior to cooking. For these reasons, use of a 22 percent overall reduction factor is not likely to result in overestimates of risk and hazard.

Residential exposure assumptions could overestimate risk for impoundment areas that are not readily accessible to residents. A recreational exposure scenario has been developed in an attempt to quantify actual exposure in hard-to-reach areas. However, at the present time, application of the residential exposure assumption is appropriate in this risk assessment for the following reasons: 1) future risk must be considered, and residential development may expand beyond current boundaries decreasing the area to which a recreational scenario would apply; and 2) the dynamic nature of the river system makes application of conservative assumptions appropriate. Periodic flooding may transport sediments from one area of an impoundment to another. Soils to which a recreational scenario is applied could be transported to an area where residential exposure is likely.

Risk Characterization

Assumptions are made using best professional judgement and the scientific literature on site risk assessments. In general, assumptions made throughout this risk assessment are conservative in that they tend to overestimate exposure and resultant risk rather than underestimate it. The overall risk to public health attributable to the site is an upper-bound probability of adverse health effects. True health effects may be lower. However, it should be noted that the individual errors from different sources may be propagated into larger errors by mathematical manipulation in the risk assessment.

Section 7
Determination of Risk-Based Sediment and Floodplain Soil Concentrations

Risk and hazard estimates associated with ingestion of fish and contact with floodplain soils have been developed and are presented in Section 5. Risk-based fish concentrations (RBC_{fish}) and sediment concentrations (RBC_{sed}) were developed to be protective of sport and subsistence anglers. Risk-based floodplain soil concentrations (RBC_{soil}) were developed to be protective of residents living near exposed floodplain soil. RBCs were developed for both cancer and noncancer endpoints. Risk-based concentrations have been developed for PCBs using an allowable cancer risk of 1 in 100,000 and a noncancer hazard index of 1.0.

Calculation of Risk-Based Fish Concentrations

RBC_{fish} were developed using the same risk and hazard algorithms used to derive risk and hazard estimates. To derive RBCs, the algorithm is reversed to solve for the concentration in fish associated with a specified cancer risk or hazard index, which in this case is 1 in 100,000 cancer risk and a hazard of 1.0. RBC_{fish} were derived using the same assumptions regarding ingestion rates, reduction factors, exposure frequencies and duration. **Table 7-1** present the RBC_{fish}.

The RBC_{fish} protective of the central tendency sport angler consuming approximately 24 meals/year of fish, or an average daily ingestion rate of 0.015 kilograms/day, is 0.042 mg/kg in fish for the cancer endpoint , 0.075 for the noncancer immunological endpoint, and 0.26 mg/kg for the noncancer reproductive endpoint. Consistent with MDEQ Surface Water Quality Division guidance, a hazard index of 0.8 was used to calculate the RBC_{fish} protective of noncancer endpoints based on a relative source contribution factor of 0.8. The relative source contribution factor accounts for the fact that exposures to PCBs may occur from activities other than those which are site-related.

The RBC_{fish} protective of the high end sport angler consuming up to 125 meals/year, or an average daily ingestion rate of 0.078 kilograms/day, is 0.021 mg/kg for the cancer endpoint, 0.048 for the immunological noncancer endpoint, and 0.16 mg/kg for the noncancer reproductive endpoint.

The RBC_{fish} protective of the subsistence angler consuming up to 179 meals/year, or an average daily ingestion rate of 0.11 kilograms/day, is 0.008 mg/kg protective of cancer endpoints, 0.016 for the most conservative noncancer endpoint and 0.056 mg/kg for the noncancer reproductive endpoint.

TABLE 7-1
RISK-BASED FISH FILLET CONCENTRATIONS (RBC_{fish}) (1)
API/PC/KR SITE

Receptor	RBC_{fish} Protective of 1E-05 Cancer Risk for PCBs (mg/kg)	RBC_{fish} Protective of 1.0 Hazard Index for PCBs (mg/kg)
Sport Angler - Central Tendency Assumes 24 meals/year 0.015 kg/day	0.042	0.075 (I) 0.26 (R)
Sport Angler - High End Assumes 125 meals/year 0.078 kg/day	0.021	0.048 (I) 0.16 (R)
Subsistence Angler Assumes 179 meals/year 0.11 kg/day	0.008	0.016 (I) 0.056 (R)

(1) Concentrations protective of both carp and smallmouth bass.
(I): Immunological Endpoint
(R): Reproductive Endpoint

The MDCH has established criteria for placing fish on the Michigan Sport Fish Consumption Advisory. For the general population, when between 11 and 49 percent of samples exceed 2 mg/kg in fish, a one meal per week advisory is issued; when greater than 50 percent of fish samples exceed 2 mg/kg, a no consumption advisory is issued. For women of childbearing age and children under 15 years of age, at concentrations greater than 0.05 mg/kg up to 0.2 mg/kg of PCBs in fish, a one meal per week advisory is issued. At concentrations greater than 0.2 mg/kg, up to 1 mg/kg of PCBs in fish, a one meal per month advisory is issued. At concentrations greater than 1.0 mg/kg up to 1.9 mg/kg of PCBs in fish, a six meals per year advisory is issued. At concentrations above 1.9 mg/kg, a no consumption advisory is issued.

The MDCH considers their PCB fish advisory concentration of less than or equal to 0.05 mg/kg in fish to be protective at an ingestion rate of 225 meals per year (0.14 kg/day) for the general population for noncancer endpoints. The MDCH does not base its advisory on cancer risk, due to political and pragmatic considerations. For subsistence anglers, who have been reported to consume between 3-4 meals per week, the RBC_{fish} developed in this HHRA indicate that concentrations in the range of 0.08 (cancer) and 0.016 (noncancer) are needed to be protective of health. The differences between the derivations of the two noncancer values are listed in the following table:

	MDCH	HHRA
Meals/year	225	179
Average daily fish consumption (kg)	0.14	0.11
Reduction by cleaning/cooking (%)	50	22
Weight of subject (kg)	70	70
Target dose, HPV or RfD (µg/kg/day)	0.05	0.02
PCB level in fish (mg/kg)	0.05	0.016

Most of the difference between the two results can be attributed to the difference between the health protection value (HPV) used by the MDCH (0.05 µg/kg/day) and the U.S. EPA RfD used in the HHRA (0.02 µg/kg/day). These values were derived from the same data by different methodologies. The Great Lakes Fish Advisory Task Force used a "weight of evidence" approach to derive the HPV used by the MDCH from data on a wide range of health effect endpoints. The U.S. EPA derives RfDs from data on specific endpoints with uncertainty and modifying factors added.

The MDCH Division of Environmental Epidemiology has reviewed this document and considers it to be adequately consistent with the MDCH protocol for issuing fish consumption advisories. Although there are differences between the cleanup levels and the MDCH first Level of Concern as cited above, MDCH considers the parameters and assumptions used in the two derivations are reasonable, the resulting levels to be reasonably close, and the cleanup levels to be more protective than the

MDCH Level of Concern. MDCH acknowledges the U.S. EPA and MDEQ's authority to establish the cleanup levels to be used at any site.

The RBC_{fish} were used to develop RBC_{sed}. RBC_{sed} represent the sediment concentrations protective of fish that are consumed at the ingestion rates specified for sport and subsistence anglers. In 1994, Region V EPA completed a draft guidance document which presented an overview of available methods for developing RBSCs and recommended the biota-to-sediment accumulation factor (BSAF) method. Three methods, the bioconcentration factor (BCF) method, the bioaccumulation factor (BAF) method and the BSAF were evaluated. The BCF and BAF methods relate fish tissue concentrations to the water column and prey consumption whereas the BSAF method related fish concentrations to sediment (Pelka, 1998). Methods were tested by comparing predicted fish concentrations with actual fish data for four locations: Saginaw, Michigan; Buffalo, New York; Ontario, Canada; and Manistique, Michigan. Region V EPA determined that the BSAF approach consistently gave the most reliable estimates of fish concentration relative to other methods.

Guidance provided by Region V EPA on the Biota to Sediment Accumulation Factor (BSAF) approach was used to develop the risk-based concentrations for sediment. This approach has been described in *Bioaccumulation Models and Applications: Setting Sediment Cleanup Goals in the Great Lakes* (Proceedings of the National Sediment Bioaccumulation Conference, September 11-13, 1996. Presented by Amy Pelka, USEPA, Region V. EPA 823-R-98-002) and in other technical memorandum.

The BSAF is calculated as follows:

$$BSAF = Cf/Cs$$

Where:

Cf = concentration in fish
Cs = concentration in sediment

Site-wide BSAFs for carp and smallmouth bass were calculated for the API/PC/KR site. Using synoptic data for fish and sediment, BSAFs of 0.88 and 1.9 were derived for smallmouth bass and carp, respectively (CDM, 1999).

Using site-specific BSAFs, the following equation can be used to derive RBSCs:

Calculation of Risk-Based Sediment Concentration

$$\text{Concentration}_{sediment} = (\text{toc} * \text{concentration}_{fish}/(\text{BSAF} * \% \text{ lipid})$$

Where:

- Site-wide toc (total organic carbon) = 8.2%
- Site-wide BSAF 0.88 (bass); 1.9 (carp)

- Site-wide lipid 0.03 (bass); 0.06 (carp)

- Risk-Based fish concentrations =

  - 0.042 (mg/kg) central tendency sport
  - 0.021 (mg/kg) high end sport anglers
  - 0.008 (mg/kg) subsistence anglers

- Hazard-Based Fish Concentrations (Immunological) =

  - 0.075 (mg/kg) central tendency sport anglers
  - 0.048 (mg/kg) high end sport anglers
  - 0.016 (mg/kg) subsistence

- Hazard - Based Fish Concentrations (Reproductive) =

  - 0.26 (mg/kg) central tendency sport anglers
  - 0.16 (mg/kg) high end sport anglers
  - 0.056 (mg/kg) subsistence

The risk-based fish concentrations were divided by a fillet to whole body conversion factor of 0.25 for smallmouth bass and 0.4 for carp. These factors were calculated form data presented in Appendix A of the Biota Investigation (BB&L, 1995a).

RBC_{sed} are presented in **Table 7-2**. RBC_{sed} are different depending on the species being protected. For the central tendency sport angler, if ingestion of smallmouth bass is being protected, the RBC_{sed} is 0.52 mg/kg for the cancer endpoint, 0.93 mg/kg for the noncancer immunological endpoint and 3.2 for the noncancer reproductive endpoint. If ingestion of a combination of smallmouth bass and carp is being protected, the RBC_{sed} is 0.42 mg/kg for cancer endpoints, 0.75 mg/kg for the immunological endpoint and 2.6 mg/kg for the reproductive endpoint.

For the high end sport angler, if ingestion of smallmouth bass is being protected, the RBC_{sed} is 0.26 mg/kg for cancer endpoints, 0.6 mg/kg for the immunological endpoint, and 2.0 mg/kg for the reproductive endpoint. If ingestion of a combination of smallmouth bass and carp is being protected, the RBC_{sed} is 0.21 mg/kg for cancer endpoints, 0.48 mg/kg for the immunological endpoint and 1.6 mg/kg for the reproductive endpoint.

TABLE 7-2
RISK-BASED SEDIMENT CONCENTRATION (RBC_{sed})
(mg/kg sediment)
API/PC/KR SITE

Scenario	RBC_{sed} Protective of Fish Ingestion at 1E-05 Cancer Risk For PCBs (mg/kg)		RBC_{sed} Protective of Fish Ingestion at 1.0 Hazard For PCBs Quotient (mg/kg)	
	Bass (2)	Bass/Carp(3)	Bass (2)	Bass/Carp(3)
Sport Angler - Central Tendency	0.52	0.42	0.93 (I) 3.2 (R)	0.75 (I) 2.6 (R)
Sport Angler - High End	0.26	0.21	0.6 (I) 2.0 (R)	0.48 (I) 1.6 (R)
Subsistence Angler	0.093	0.075	0.20 (I) 0.70 (R)	0.16 (I) 0.57 (R)

(1) Incorporates fillet to whole body conversion factor of 0.25 for bass and 0.4 for carp.

(2) Assumes 3 percent lipid.

(3) Assumes 6 percent lipid.

For the subsistence angler, if ingestion of smallmouth bass is being protected, the RBC_{sed} is 0.093 mg/kg for cancer endpoints, 0.20 mg/kg for the immunological endpoint, and 0.70 mg/kg for the reproductive endpoint. If ingestion of a combination of smallmouth bass and carp is being protected, the RBC_{sed} is 0.075 for cancer endpoints, 0.16 mg/kg for the immunological endpoint, and 0.57 mg/kg for the reproductive endpoint.

Calculation of Risk-Based Soil Concentrations

The risk-based floodplain soil concentration (RBC_{soil}) were derived in the same manner as the RBC_{fish}, i.e., the risk and hazard algorithms were reversed and were solved using a cancer risk of 1 in 100,000 and a hazard index of 1.0. The same exposure assumptions used to estimate risk and hazard were used to derive the RBC_{soil}.

Table 7-3 presents the RBC_{soil} protective of residents. The RBC_{soil} protective of residents for the cancer endpoint is 2.6 mg/kg . For noncancer endpoints, the $RBSC_{soil}$ is 8.5 mg/kg for the reproductive endpoint and 5 mg/kg for the immunological endpoint.

TABLE 7-3
RISK-BASED FLOODPLAIN SOIL CONCENTRATIONS (RBC_{SOIL})
PROTECTIVE OF RESIDENTS
API/PC/KR SITE

Receptor	RBC_{soil} Protective of 1E-05 Cancer Risk (mg/kg)	RBC_{soil} Protective of 1.0 Hazard Quotient (mg/kg)
Resident	2.6	8.5 (R) 5.0 (I)

Notes (R) = Reproductive endpoint
(I) = Immunological endpoint

Table **7-4** presents the RBC_{soil} protective of recreationalists. For the cancer endpoint the RBC_{soil} is 17 mg/kg. For noncancer endpoints, the RBC_{soil} is 35 mg/kg for the reproductive endpoint and 32 mg/kg for the immunological endpoint.

TABLE 7-4
RISK-BASED FLOODPLAIN SOIL CONCENTRATIONS (RBC_{SOIL})
PROTECTIVE OF RECREATIONAL VISITORS
API/PC/KR SITE

Receptor	RBC_{soil} Protective of 1E-05 Cancer Risk (mg/kg)	RBC_{soil} Protective of 1.0 Hazard Quotient (mg/kg)
Resident	17	35 (R) 32 (I)

Notes: (R) = Reproductive endpoint
(I) = Immunological endpoint

Appendix A presents the spreadsheets used to derive RBCs.

Section 8
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Appendix A
Calculation of Risk and Hazard

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Base - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	0.015	1	365		2	70	730		2.0E-04		7.00E-05	2.9E+00	
Total PCBs (Immunological)	0.95	0.015	1	365	30		70		10,950		2.0E-04	2.00E-05		1.0E+01
										Total Hazard Index =			**2.9E+00**	**1.0E+01**

Small Mouth Base - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	0.015	1	365	39	70	25,550	1.1E-04	2	2.3E-04
								Excess Lifetime Cancer Risk =		**2.3E-04**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	5.68	0.011	0.004	1	365		2	70	730		4.6E-04		7.00E-05	6.5E+00	
Total PCBs (Immunological)	0.95	5.68	0.011	0.004	1	365	30		70		10,950		4.6E-04	2.00E-05		2.3E+01
												Total Hazard Index =			**6.5E+00**	**2.3E+01**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	5.68	0.011	0.004	1	365	39	70	25,550	2.5E-04	2	5.1E-04
									Excess Lifetime Risk =			**5.1E-04**

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 6

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	0.015	1	365		2	70	730		2.1E-04		7.00E-05	3.0E+00	
Total PCBs (Immunological)	0.98	0.015	1	365	30		70		10,950		2.1E-04	2.00E-05		1.1E+01
											Total Hazard Index =		3.0E+00	1.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	0.015	1	365	39	70	25,550	1.2E-04	2	2.4E-04
									Excess Lifetime Cancer Risk =	2.4E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	3.57	0.011	0.004	1	365		2	70	730		3.5E-04		7.00E-05	4.99E+00	
Total PCBs (Immunological)	0.98	3.57	0.011	0.004	1	365	30		70		10,950		3.5E-04	2.00E-05		1.7E+01
												Total Hazard Index =			5.0E+00	1.7E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	3.57	0.011	0.004	1	365	39	70	25,550	1.9E-04	2	3.9E-04
										Excess Lifetime Risk =		3.9E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno Exposure Duration (years)	Repro Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	0.015	1	365		2	70	730		3.1E-04		7.00E-05	4.5E+00	
Total PCBs (Immunological)	1.47	0.015	1	365	30		70		10,950		3.1E-04	2.00E-05		1.6E+01
												Total Hazard Index =	4.5E+00	1.6E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	0.015	1	365	39	70	25,550	1.8E-04	2	3.5E-04
									Excess Lifetime Cancer Risk =	3.5E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	2.42	0.011	0.004	1	365		2	70	730		3.7E-04		7.00E-05	5.2E+00	
Total PCBs (Immunological)	1.47	2.42	0.011	0.004	1	365	30		70		10,950		3.7E-04	2.00E-05		1.8E+01
													Total Hazard Index =		5.2E+00	1.8E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc of of Chemcial in Raw SMB Fillet (mg/kg)	Conc of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	2.42	0.011	0.004	1	365	39	70	25,550	2.0E-04	2	4.1E-04
										Excess Lifetime Risk =		4.1E-04

BLE
ORT FISHING - AVERAGE CONCENTRATIONS

SA 8

all Mouth Bass - Non Cancer (100% consumption of small mouth bass)

hemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
otal PCBs (Reproductive)	1.95	0.015	1	365		2	70	730		4.2E-04		7.00E-05	6.0E+00	
otal PCBs (Immunological)	1.95	0.015	1	365	30		70		10,950		4.2E-04	2.00E-05		2.1E+01

Total Hazard Index = 6.0E+00 2.1E+01

mall Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	0.015	1	365	39	70	25,550	2.3E-04	2	4.7E-04

Excess Lifetime Cancer Risk = 4.7E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.95	4.55	0.011	0.004	1	365		2	70	730		5.6E-04		7.00E-05	7.96E+00	
Total PCBs (Immunological)	1.95	4.55	0.011	0.004	1	365	30		70		10,950		5.6E-04	2.00E-05		2.8E+01

Total Hazard Index = 8.0E+00 2.8E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	4.55	0.011	0.004	1	365	39	70	25,550	3.1E-04	2	6.2E-04

Excess Lifetime Risk = 6.2E-04

ABLE
PORT FISHING - AVERAGE CONCENTRATIONS

BSA 9

mall Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	0.015	1	365		2	70	730		4.1E-04		7.00E-05	5.8E+00	
Total PCBs (Immunological)	1.89	0.015	1	365	30		70		10,950		4.1E-04	2.00E-05		2.0E+01
												Total Hazard Index =	5.8E+00	2.0E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	0.015	1	365	39	70	25,550	2.3E-04	2	4.5E-04
									Excess Lifetime Cancer Risk =	4.5E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.24	0.011	0.004	1	365		2	70	730		3.7E-04		7.00E-05	5.29E+00	
Total PCBs (Immunological)	1.89	1.24	0.011	0.004	1	365	30		70		10,950		3.7E-04	2.00E-05		1.9E+01
													Total Hazard Index =		5.3E+00	1.9E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.24	0.011	0.004	1	365	39	70	25,550	2.1E-04	2	4.1E-04
										Excess Lifetime Risk =		4.1E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 10

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	0.015	1	365		2	70	730		4.1E-04		7.00E-05	5.8E+00	
Total PCBs (Immunological)	1.89	0.015	1	365	30		70		10,950		4.1E-04	2.00E-05		2.0E+01
												Total Hazard Index =	5.8E+00	2.0E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	0.015	1	365	39	70	25,550	2.3E-04	2	4.5E-04
								Excess Lifetime Cancer Risk =		4.5E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	7.60	0.011	0.004	1	365		2	70	730		7.1E-04		7.00E-05	1.02E+01	
Total PCBs (Immunological)	1.89	7.60	0.011	0.004	1	365	30		70		10,950		7.1E-04	2.00E-05		3.6E+01
													Total Hazard Index =		1.0E+01	3.6E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	7.60	0.011	0.004	1	365	39	70	25,550	4.0E-04	2	7.9E-04
									Excess Lifetime Risk =			7.9E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	0.015	1	365		2	70	730		1.6E-04		7.00E-05	2.3E+00	
Total PCBs (Immunological)	0.76	0.015	1	365	30		70		10,950		1.6E-04	2.00E-05		8.1E+00
											Total Hazard Index =		**2.3E+00**	**8.1E+00**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.76	0.015	1	365	39	70	25,550	9.0E-05	2	1.8E-04
							Excess Lifetime Cancer Risk =			**1.8E-04**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	4.83	0.011	0.004	1	365		2	70	730		3.8E-04		7.00E-05	5.43E+00	
Total PCBs (Immunological)	0.76	4.83	0.011	0.004	1	365	30		70		10,950		3.8E-04	2.00E-05		1.9E+01
												Total Hazard Index =			**5.4E+00**	**1.9E+01**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.76	4.83	0.011	0.004	1	365	39	70	25,550	2.1E-04	2	4.2E-04
									Excess Lifetime Risk =			**4.2E-04**

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.23	0.015	1	365		2	70	730		6.9E-04		7.00E-05	9.9E+00	
Total PCBs (Immunological	3.23	0.015	1	365	30		70		10,950		6.9E-04	2.00E-05		3.5E+01

Total Hazard Index = 9.9E+00 3.5E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	0.015	1	365	39	70	25,550	4.6E-04	2	9.3E-04

Excess Lifetime Cancer Risk = 9.3E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.89	17.34	0.011	0.004	1	365		2	70	730		1.6E-03		7.00E-05	2.2E+01	
Total PCBs (Immunological	3.89	17.34	0.011	0.004	1	365	30		70		10,950		1.6E-03	2.00E-05		7.8E+01

Total Hazard Index = 2.2E+01 7.8E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	17.34	0.011	0.004	1	365	39	70	25,550	8.7E-04	2	1.7E-03

Excess Lifetime Risk = 1.7E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 6

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	0.015	1	365		2	70	730		7.8E-04		7.00E-05	1.1E+01	
Total PCBs (Immunological)	3.66	0.015	1	365	30		70		10,950		7.8E-04	2.00E-05		3.9E+01
												Total Hazard Index =	1.1E+01	3.9E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.66	0.015	1	365	39	70	25,550	4.4E-04	2	8.7E-04
									Excees Lifetime Cancer Risk =	8.7E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequenc days/year	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake /mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	8.28	0.011	0.004	1	365	2		70	730		1.0E-03		7.00E-05	1.47E+01	
Total PCBs (Immunological)	3.66	8.28	0.011	0.004	1	365		30	70		10,950		1.0E-03	2.00E-05		5.2E+01
													Total Hazard Index =		1.5E+01	5.2E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequenc days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.66	8.28	0.011	0.004	1	365	39	70	25,550	5.7E-04	2	1.1E-03
											Excess Lifetime Risk =	1.1E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	0.015	1	365		2	70	730		8.0E-04		7.00E-05	1.1E+01	
Total PCBs (Immunological	3.73	0.015	1	365	30		70		10,950		8.0E-04	2.00E-05		4.0E+01
												Total Hazard Index =	**1.1E+01**	**4.0E+01**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	0.015	1	365	39	70	25,550	4.5E-04	2	8.9E-04
									Excess Lifetime Cancer Risk =	**8.9E-04**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	6.40	0.011	0.004	1	365	2		70	730		9.4E-04		7.00E-05	1.35E+01	
Total PCBs (Immunological	3.73	6.40	0.011	0.004	1	365		30	70		10,950		9.4E-04	2.00E-05		4.7E+01
													Total Hazard Index =		**1.3E+01**	**4.7E+01**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in *Raw SMB Fillet* (mg/kg)	Concentration of Chemcial in *Raw CAR Fillet* (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	6.40	0.011	0.004	1	365	39	70	25,550	5.3E-04	2	1.1E-03
										Excess Lifetime Risk =		**1.1E-03**

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	0.015	1	365		2	70	730		9.0E-04		7.00E-05	1.3E+01	
Total PCBs (Immunological	4.19	0.015	1	365	30		70		10,950		9.0E-04	2.00E-05		4.5E+01

Total Hazard Index = 1.3E+01 4.5E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	0.015	1	365	39	70	25,550	5.0E-04	2	1.0E-03

Excess Lifetime Cancer Risk = 1.0E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	9.60	0.011	0.004	1	365	2		70	730		1.2E-03		7.00E-05	1.70E+01	
Total PCBs (Immunological	4.19	9.60	0.011	0.004	1	365		30	70		10,950		1.2E-03	2.00E-05		5.9E+01

Total Hazard Index = 1.7E+01 5.9E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	9.60	0.011	0.004	1	365	39	70	25,550	6.6E-04	2	1.3E-03

Excess Lifetime Risk = 1.3E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 9

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.80	0.015	1	365		2	70	730		1.2E-03		7.00E-05	1.8E+01	
Total PCBs (Immunological	5.80	0.015	1	365	30		70		10,950		1.2E-03	2.00E-05		6.2E+01
											Total Hazard Index =		**1.8E+01**	**6.2E+01**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	5.80	0.015	1	365	39	70	25,550	6.9E-04	2	1.4E-03
							Excees Lifetime Cancer Risk =			**1.4E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.80	6.50	0.011	0.004	1	365	2		70	730		1.3E-03		7.00E-05	1.83E+01	
Total PCBs (Immunological	5.80	6.50	0.011	0.004	1	365		30	70		10,950		1.3E-03	2.00E-05		6.4E+01
												Total Hazard Index =			**1.8E+01**	**6.4E+01**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	5.80	6.50	0.011	0.004	1	365	39	70	25,550	7.1E-04	2	1.4E-03
									Excess Lifetime Risk =			**1.4E-03**

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 10

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	0.015	1	365		2	70	730		5.2E-04		7.00E-05	7.4E+00	
Total PCBs (Immunological	2.42	0.015	1	365	30		70		10,950		5.2E-04	2.00E-05		2.6E+01
											Total Hazard Index =		7.4E+00	2.6E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	0.015	1	365	39	70	25,550	2.9E-04	2	5.8E-04
									Excees Lifetime Cancer Risk =	5.8E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	17.00	0.011	0.004	1	365	2		70	730		1.3E-03		7.00E-05	1.86E+01	
Total PCBs (Immunological	2.42	17.00	0.011	0.004	1	365		30	70		10,950		1.3E-03	2.00E-05		6.5E+01
												Total Hazard Index =			1.9E+01	6.5E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	17.00	0.011	0.004	1	365	39	70	25,550	7.2E-04	2	1.4E-03
										Excess Lifetime Risk =		1.4E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	0.015	1	365		2	70	730		9.2E-04		7.00E-05	1.3E+01	
Total PCBs (Immunological)	4.30	0.015	1	365	30		70		10,950		9.2E-04	2.00E-05		4.6E+01
										Total Hazard Index =			**1.3E+01**	**4.6E+01**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.30	0.015	1	365	39	70	25,550	5.1E-04	2	1.0E-03
								Excess Lifetime Cancer Risk =		**1.0E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	17.30	0.011	0.004	1	365	2		70	730		1.6E-03		7.00E-05	2.31E+01	
Total PCBs (Immunological)	4.30	17.30	0.011	0.004	1	365		30	70		10,950		1.6E-03	2.00E-05		8.1E+01
											Total Hazard Index =				**2.3E+01**	**8.1E+01**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.30	17.30	0.011	0.004	1	365	39	70	25,550	9.0E-04	2	1.8E-03
									Excess Lifetime Risk =			**1.8E-03**

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	0.74	0.078	0.5	365		2	70	730		4.1E-04		7.00E-05	5.9E+00	
Total PCBs (Immunological)	0.95	0.74	0.078	0.5	365	30		70		10,950		4.1E-04	2.00E-05		2.1E+01
													Total Hazard Index =	5.9E+00	2.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	0.74	0.078	0.5	365	39	70	25,550	2.3E-04	2	4.6E-04
										Excess Lifetime Cancer Risk =	4.6E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	0.74	5.68	4.43	0.059	0.020	0.5	365		2	70	730		9.3E-04		7.00E-05	1.3E+01	
Total PCBs (Immunological)	0.95	0.74	5.68	4.43	0.059	0.020	0.5	365	30		70		10,950		9.3E-04	2.00E-05		4.6E+01
														Total Hazard Index =			1.3E+01	4.6E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	0.74	5.68	4.43	0.059	0.020	0.5	365	39	70	25,550	5.2E-04	2	1.0E-03
													Excess Lifetime Risk =	1.0E-03

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 6

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemical in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	0.77	0.078	0.5	365		2	70	730		4.3E-04		7.00E-05	6.1E+00	
Total PCBs (Immunological)	0.98	0.77	0.078	0.5	365	30		70		10,950		4.3E-04	2.00E-05		2.1E+01
													Total Hazard Index =	6.1E+00	2.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	0.77	0.078	0.5	365	39	70	25,550	2.4E-04	2	4.8E-04
										Excess Lifetime Cancer Risk =	4.8E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	0.77	3.57	2.78	0.059	0.020	0.5	365		2	70	730		7.1E-04		7.00E-05	1.01E+01	
Total PCBs (Immunological)	0.98	0.77	3.57	2.78	0.059	0.020	0.5	365	30		70		10,950		7.1E-04	2.00E-05		3.5E+01
														Total Hazard Index =			1.0E+01	3.5E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	0.77	3.57	2.78	0.059	0.020	0.5	365	39	70	25,550	3.9E-04	2	7.9E-04
													Excess Lifetime Risk =	7.9E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	1.15	0.078	0.5	365		2	70	730		8.4E-04		7.00E-05	9.1E+00	
Total PCBs (Immunological)	1.47	1.15	0.078	0.5	365	30		70		10,950		8.4E-04	2.00E-05		3.2E+01
													Total Hazard Index =	9.1E+00	3.2E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	1.15	0.078	0.5	365	39	70	25,550	3.6E-04	2	7.1E-04
									Excess Lifetime Cancer Risk =		7.1E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	1.15	2.42	1.89	0.059	0.020	0.5	365		2	70	730		7.4E-04		7.00E-05	1.06E+01	
Total PCBs (Immunological)	1.47	1.15	2.42	1.89	0.059	0.020	0.5	365	30		70		10,950		7.4E-04	2.00E-05		3.7E+01
														Total Hazard Index =			1.1E+01	3.7E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	1.15	2.42	1.89	0.059	0.020	0.5	365	39	70	25,550	4.1E-04	2	8.3E-04
											Excess Lifetime Risk =			8.3E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.95	1.52	0.078	0.5	365		2	70	730		1.1E-03		7.00E-05	1.6E+01	
Total PCBs (Immunological)	1.95	1.52	0.078	0.5	365	30		70		10,950		8.5E-04	2.00E-05		4.2E+01
													Total Hazard Index =	1.6E+01	4.2E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	1.52	0.078	0.5	365	39	70	25,550	4.7E-04	2	9.4E-04
									Excess Lifetime Cancer Risk =		9.4E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.95	1.52	4.55	3.55	0.059	0.020	0.5	365		2	70	730		1.1E-03		7.00E-05	1.61E+01	
Total PCBs (Immunological)	1.95	1.52	4.55	3.55	0.059	0.020	0.5	365	30		70		10,950		1.1E-03	2.00E-05		5.6E+01
														Total Hazard Index =			1.6E+01	5.6E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	1.52	4.55	3.55	0.059	0.020	0.5	365	39	70	25,550	6.3E-04	2	1.3E-03
											Excess Lifetime Risk =			1.3E-03

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 9

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.47	0.078	0.5	365		2	70	730		8.2E-04		7.00E-05	1.2E+01	
Total PCBs (Immunological)	1.89	1.47	0.078	0.5	365	30		70		10,950		8.2E-04	2.00E-05		4.1E+01
													Total Hazard Index =	1.2E+01	4.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.47	0.078	0.5	365	39	70	25,550	4.6E-04	2	9.2E-04
										Excess Lifetime Cancer Risk =	9.2E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.47	1.24	0.97	0.059	0.020	0.5	365		2	70	730		7.5E-04		7.00E-05	1.07E+01	
Total PCBs (Immunological)	1.89	1.47	1.24	0.97	0.059	0.020	0.5	365	30		70		10,950		7.5E-04	2.00E-05		3.8E+01
																Total Hazard Index =	1.1E+01	3.8E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.47	1.24	0.97	0.059	0.020	0.5	365	39	70	25,550	4.2E-04	2	8.4E-04
											Excess Lifetime Risk =			8.4E-04

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 10

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.48	0.078	0.5	365		2	70	730		8.2E-04		7.00E-05	1.2E+01	
Total PCBs (Immunological)	1.89	1.48	0.078	0.5	365	30		70		10,950		8.2E-04	2.00E-05		4.1E+01
													Total Hazard Index =	1.2E+01	4.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.48	0.078	0.5	365	39	70	25,550	4.6E-04	2	9.2E-04
										Excess Lifetime Cancer Risk =	9.2E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.48	7.60	5.93	0.059	0.020	0.5	365		2	70	730		1.4E-03		7.00E-05	2.06E+01	
Total PCBs (Immunological)	1.89	1.48	7.60	5.93	0.059	0.020	0.5	365	30		70		10,950		1.4E-03	2.00E-05		7.2E+01
														Total Hazard Index =			2.1E+01	7.2E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.48	7.60	5.93	0.059	0.020	0.5	365	39	70	25,550	8.0E-04	2	1.6E-03
											Excess Lifetime Risk =			1.6E-03

TABLE
SPORT FISHING - AVERAGE CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	0.59	0.078	0.5	365		2	70	730		3.3E-04		7.00E-05	4.7E+00	
Total PCBs (Immunological)	0.76	0.59	0.078	0.5	365	30		70		10,950		3.3E-04	2.00E-05		1.6E+01
													Total Hazard Index =	4.7E+00	1.6E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.76	0.59	0.078	0.5	365	39	70	25,550	1.8E-04	2	3.7E-04
										Excess Lifetime Cancer Risk =	3.7E-04

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc: of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	0.59	4.83	3.76	0.059	0.020	0.5	365		2	70	730		7.7E-04		7.00E-05	1.10E+01	
Total PCBs (Immunological)	0.76	0.59	4.83	3.76	0.059	0.020	0.5	365	30		70		10,950		7.7E-04	2.00E-05		3.9E+01
														Total Hazard Index =			1.1E+01	3.9E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.76	0.59	4.83	3.76	0.059	0.020	0.5	365	39	70	25,550	4.3E-04	2	8.6E-04
												Excess Lifetime Risk =		8.6E-04

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.23	2.52	0.078	0.5	365		2	70	730		1.4E-03		7.00E-05	2.0E+01	
Total PCBs (Immunological	3.23	2.52	0.078	0.5	365	30		70		10,950		1.4E-03	2.00E-05		7.0E+01

Total Hazard Index = **2.0E+01** **7.0E+01**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	3.03	0.078	0.5	365	39	70	25,550	9.4E-04	2	1.9E-03

Excees Lifetime Cancer Risk = **1.9E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.89	3.03	17.34	13.53	0.059	0.020	0.5	365		2	70	730		3.2E-03		7.00E-05	4.5E+01	
Total PCBs (Immunological	3.89	3.03	17.34	13.53	0.059	0.020	0.5	365	30		70		10,950		3.2E-03	2.00E-05		1.6E+02

Total Hazard Index = **4.5E+01** **1.6E+02**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	3.03	17.34	13.53	0.059	0.020	0.5	365	39	70	25,550	1.8E-03	2	3.5E-03

Excess Lifetime Risk = **3.5E-03**

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	2.85	0.078	0.5	365		2	70	730		1.6E-03		7.00E-05	2.3E+01	
Total PCBs (Immunological)	3.66	2.85	0.078	0.5	365	30		70		10,950		1.6E-03	2.00E-05		8.0E+01

Total Hazard Index = 2.3E+01 8.0E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.66	2.85	0.078	0.5	365	39	70	25,550	8.9E-04	2	1.8E-03

Excess Lifetime Cancer Risk = 1.8E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	2.85	8.28	6.46	0.059	0.020	0.5	365	2		70	730		2.1E-03		7.00E-05	2.99E+01	
Total PCBs (immunological)	3.66	2.85	8.28	6.46	0.059	0.020	0.5	365		30	70		10,950		2.1E-03	2.00E-05		1.0E+02

Total Hazard Index = 3.0E+01 1.0E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg-day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.66	2.85	8.28	6.46	0.059	0.020	0.5	365	39	70	25,550	1.2E-03	2	2.3E-03

Excess Lifetime Risk = 2.3E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	2.91	0.078	0.5	365		2	70	730		1.6E-03		7.00E-05	2.3E+01	
Total PCBs (Immunological	3.73	2.91	0.078	0.5	365	30		70		10,950		1.6E-03	2.00E-05		8.1E+01

Total Hazard Index = 2.3E+01 8.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake mg/kg-da	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	2.91	0.078	0.5	365	39	70	25,550	9.0E-04	2	1.8E-03

Excees Lifetime Cancer Risk = 1.8E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	2.91	6.40	4.99	0.059	0.020	0.5	365	2		70	730		1.9E-03		7.00E-05	2.73E+01	
Total PCBs (Immunological	3.73	2.91	6.40	4.99	0.059	0.020	0.5	365		30	70		10,950		1.9E-03	2.00E-05		9.6E+01

Total Hazard Index = 2.7E+01 9.6E+01

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	2.91	6.40	4.99	0.059	0.020	0.5	365	39	70	25,550	1.1E-03	2	2.1E-03

Excess Lifetime Risk = 2.1E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	3.27	0.078	0.5	365		2	70	730		1.8E-03		7.00E-05	2.6E+01	
Total PCBs (Immunological	4.19	3.27	0.078	0.5	365	30		70		10,950		1.8E-03	2.00E-05		9.1E+01
													Total Hazard Index =	2.6E+01	9.1E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	3.27	0.078	0.5	365	39	70	25,550	1.0E-03	2	2.0E-03
									Excees Lifetime Cancer Risk =		2.0E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	3.27	9.60	7.49	0.059	0.020	0.5	365	2		70	730		2.4E-03		7.00E-05	3.44E+01	
Total PCBs (Immunological	4.19	3.27	9.60	7.49	0.059	0.020	0.5	365		30	70		10,950		2.4E-03	2.00E-05		1.2E+02
														Total Hazard Index =			3.4E+01	1.2E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	3.27	9.60	7.49	0.059	0.020	0.5	365	39	70	25,550	1.3E-03	2	2.7E-03
											Excess Lifetime Risk =			2.7E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 9

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.80	4.52	0.078	0.5	365		2	70	730		2.5E-03		7.00E-05	3.6E+01	
Total PCBs (Immunological	5.80	4.52	0.078	0.5	365	30		70		10,950		2.5E-03	2.00E-05		1.3E+02
													Total Hazard Index =	3.6E+01	1.3E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	5.80	4.52	0.078	0.5	365	39	70	25,550	1.4E-03	2	2.8E-03
										Excees Lifetime Cancer Risk =	2.8E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.80	4.52	6.50	5.07	0.059	0.020	0.5	365	2		70	730		2.6E-03		7.00E-05	3.71E+01	
Total PCBs (Immunological	5.80	4.52	6.50	5.07	0.059	0.020	0.5	365		30	70		10,950		2.6E-03	2.00E-05		1.3E+02
														Total Hazard Index =			3.7E+01	1.3E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)	Chemical Specific Cancer Risk
Total PCBs	5.80	4.52	6.50	5.07	0.059	0.020	0.5	365	39	70	25,550	1.4E-03	2	2.9E-03
												Excess Lifetime Risk =		2.9E-03

ABLE
PORT FISHING - MAXIMUM CONCENTRATIONS

BSA 10

mall Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	1.89	0.078	0.5	365		2	70	730		1.1E-03		7.00E-05	1.5E+01	
Total PCBs (Immunological	2.42	1.89	0.078	0.5	365	30		70		10,950		1.1E-03	2.00E-05		5.3E+01

Total Hazard Index = 1.5E+01 5.3E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	1.89	0.078	0.5	365	39	70	25,550	5.9E-04	2	1.2E-03

Excees Lifetime Cancer Risk = 1.2E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	1.89	17.00	13.26	0.059	0.020	0.5	365	2		70	730		2.6E-03		7.00E-05	3.77E+01	
Total PCBs (Immunological	2.42	1.89	17.00	13.26	0.059	0.020	0.5	365		30	70		10,950		2.6E-03	2.00E-05		1.3E+02

Total Hazard Index = 3.8E+01 1.3E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	1.89	17.00	13.26	0.059	0.020	0.5	365	39	70	25,550	1.5E-03	2	2.9E-03

Excess Lifetime Risk = 2.9E-03

TABLE
SPORT FISHING - MAXIMUM CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	3.35	0.078	0.5	365		2	70	730		1.9E-03		7.00E-05	2.7E+01	
Total PCBs (Immunological)	4.30	3.35	0.078	0.5	365	30		70		10,950		1.9E-03	2.00E-05		9.3E+01
													Total Hazard Index =	**2.7E+01**	**9.3E+01**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.30	3.35	0.078	0.5	365	39	70	25,550	1.0E-03	2	2.1E-03
									Excess Lifetime Cancer Risk =		**2.1E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Repro. Exposure Duration (years)	Immuno. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	3.35	17.30	13.49	0.059	0.020	0.5	365	2		70	730		3.3E-03		7.00E-05	4.69E+01	
Total PCBs (Immunological)	4.30	3.35	17.30	13.49	0.059	0.020	0.5	365		30	70		10,950		3.3E-03	2.00E-05		1.6E+02
														Total Hazard Index =			**4.7E+01**	**1.6E+02**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.30	3.35	17.30	13.49	0.059	0.020	0.5	365	39	70	25,550	1.8E-03	2	3.7E-03
											Excess Lifetime Risk =			**3.7E-03**

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	0.74	0.11	1	365		2	70	730		1.2E-03		7.00E-05	1.7E+01	
Total PCBs (Immunological)	0.95	0.74	0.11	1	365	30		70		10,950		1.2E-03	2.00E-05		5.8E+01
													Total Hazard Index =	1.7E+01	5.8E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	0.74	0.11	1	365	39	70	25,550	8.5E-04	2	1.3E-03
										Excess Lifetime Cancer Risk =	1.3E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.95	0.74	5.68	4.43	0.08	0.03	1	365		2	70	730		2.6E-03		7.00E-05	3.7E+01	
Total PCBs (Immunological)	0.95	0.74	5.68	4.43	0.08	0.03	1	365	30		70		10,950		2.6E-03	2.00E-05		1.3E+02
																Total Hazard Index =	3.7E+01	1.3E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.95	0.74	5.68	4.43	0.08	0.03	1	366	39	70	25,560	1.5E-03	2	2.9E-03
													Excess Lifetime Risk =	2.9E-03

SMB: Small Mouth Bass
CAR: Carp

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 6

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	0.77	0.11	1	365		2	70	730		1.2E-03		7.00E-05	1.7E+01	
Total PCBs (Immunological)	0.98	0.77	0.11	1	365	30		70		10,950		1.2E-03	2.00E-05		6.0E+01
													Total Hazard Index =	1.7E+01	6.0E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	0.77	0.11	1	365	39	70	25,550	6.7E-04	2	1.3E-03
										Excess Lifetime Cancer Risk =	1.3E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.98	0.77	3.57	2.78	0.08	0.03	1	365		2	70	730		2.0E-03		7.00E-05	2.9E+01	
Total PCBs (Immunological)	0.98	0.77	3.57	2.78	0.08	0.03	1	365	30		70		10,950		2.0E-03	2.00E-05		1.0E+02
														Total Hazard Index =			2.9E+01	1.0E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.98	0.77	3.57	2.78	0.08	0.03	1	365	39	70	25,550	1.1E-03	2	2.2E-03
											Excess Lifetime Risk =			2.2E-03

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	1.15	0.11	1	365		2	70	730		1.8E-03		7.00E-05	2.6E+01	
Total PCBs (Immunological)	1.47	1.15	0.11	1	365	30		70		10,950		1.8E-03	2.00E-05		9.0E+01
													Total Hazard Index =	2.6E+01	9.0E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	1.15	0.11	1	365	39	70	25,550	1.0E-03	2	2.0E-03
										Excess Lifetime Cancer Risk =	2.0E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.47	1.15	2.42	1.89	0.08	0.03	1	365		2	70	730		2.1E-03		7.00E-05	3.0E+01	
Total PCBs (Immunological)	1.47	1.15	2.42	1.89	0.08	0.03	1	365	30		70		10,950		2.1E-03	2.00E-05		1.0E+02
														Total Hazard Index =			3.0E+01	1.0E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.47	1.15	2.42	1.89	0.08	0.03	1	365	39	70	25,550	1.2E-03	2	2.3E-03
											Excess Lifetime Risk =			2.3E-03

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.95	1.52	0.11	1	365		2	70	730		2.4E-03		7.00E-05	3.4E+01	
Total PCBs (Immunological)	1.95	1.52	0.11	1	365	30		70		10,950		2.4E-03	2.00E-05		1.2E+02

Total Hazard Index = 3.4E+01 1.2E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	1.52	0.11	1	365	39	70	25,550	1.3E-03	2	2.7E-03

Excess Lifetime Cancer Risk = 2.7E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.95	1.52	4.55	3.55	0.08	0.03	1	365		2	70	730		3.2E-03		7.00E-05	4.6E+01	
Total PCBs (Immunological)	1.95	1.52	4.55	3.55	0.08	0.03	1	365	30		70		10,950		3.2E-03	2.00E-05		1.6E+02

Total Hazard Index = 4.6E+01 1.6E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.95	1.52	4.55	3.55	0.08	0.03	1	365	39	70	25,550	1.8E-03	2	3.5E-03

Excess Lifetime Risk = 3.5E-03

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 9

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.47	0.11	1	365		2	70	730		2.3E-03		7.00E-05	3.3E+01	
Total PCBs (Immunological)	1.89	1.47	0.11	1	365	30		70		10,950		2.3E-03	2.00E-05		1.2E+02
													Total Hazard Index =	3.3E+01	1.2E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.47	0.11	1	365	39	70	25,550	1.3E-03	2	2.6E-03
										Excess Lifetime Cancer Risk =	2.6E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.47	1.24	0.97	0.08	0.03	1	365		2	70	730		2.1E-03		7.00E-05	3.0E+01	
Total PCBs (Immunological)	1.89	1.47	1.24	0.97	0.08	0.03	1	365	30		70		10,950		2.1E-03	2.00E-05		1.1E+02
														Total Hazard Index =			3.0E+01	1.1E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.47	1.24	0.97	0.08	0.03	1	365	39	70	25,550	1.2E-03	2	2.4E-03
											Excess Lifetime Risk =			2.4E-03

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 10

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemical in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.48	0.11	1	365		2	70	730		2.3E-03		7.00E-05	3.3E+01	
Total PCBs (Immunological)	1.89	1.48	0.11	1	365	30		70		10,950		2.3E-03	2.00E-05		1.2E+02

Total Hazard Index = 3.3E+01 1.2E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemical in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.48	0.11	1	365	39	70	25,550	1.3E-03	2	2.6E-03

Excess Lifetime Cancer Risk = 2.6E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemical in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemical in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	1.89	1.48	7.60	5.93	0.08	0.03	1	365		2	70	730		4.1E-03		7.00E-05	5.8E+01	
Total PCBs (Immunological)	1.89	1.48	7.60	5.93	0.08	0.03	1	365	30		70		10,950		4.1E-03	2.00E-05		2.0E+02

Total Hazard Index = 5.8E+01 2.0E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemical in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemical in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	1.89	1.48	7.60	5.93	0.08	0.03	1	365	39	70	25,550	2.3E-03	2	4.5E-03

Excess Lifetime Risk 4.5E-03

TABLE
SUBSISTENCE FISHING - AVERAGE CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Conc.of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	0.59	0.11	1	365		2	70	730		9.3E-04		7.00E-05	1.3E+01	
Total PCBs (Immunological)	0.76	0.59	0.11	1	365	30		70		10,950		9.3E-04	2.00E-05		4.6E+01
													Total Hazard Index =	1.3E+01	4.6E+01

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Conc. of Chemcial in Raw Fish Fillet (mg/kg)	Conc.of Chemical in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor mg/kg-day)	Chemical Specific Cancer Risk
Total PCBs	0.76	0.59	0.11	1	365	39	70	25,550	5.2E-04	2	1.0E-03
									Excess Lifetime Cancer Risk =		1.0E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Conc. of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	0.76	0.59	4.83	3.76	0.08	0.03	1	365		2	70	730		2.2E-03		7.00E-05	3.1E+01	
Total PCBs (Immunological)	0.76	0.59	4.83	3.76	0.08	0.03	1	365	30		70		10,950		2.2E-03	2.00E-05		1.1E+02
														Total Hazard Index =			3.1E+01	1.1E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Conc. of of Chemcial in Raw SMB Fillet (mg/kg)	Conc.of Chemical in Cooked SMB Fillet (mg/kg)	Conc. of of Chemcial in Raw CAR Fillet (mg/kg)	Conc. of of Chemical in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.76	0.59	4.83	3.76	0.08	0.03	1	365	39	70	25,550	1.2E-03	2	2.4E-03
											Excess Lifetime Risk =			2.4E-03

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 3,4,5 (combination)

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.89	3.03	0.11	1	365		2	70	730		4.8E-03		7.00E-05	6.8E+01	
Total PCBs (Immunological)	3.89	3.03	0.11	1	365	30		70		10,950		4.8E-03	2.00E-05		2.4E+02

Total Hazard Index = **6.8E+01** **2.4E+02**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	3.03	0.11	1	365	39	70	25,550	2.7E-03	2	5.3E-03

Excess Lifetime Cancer Risk = **5.3E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.89	3.03	17.34	13.53	0.08	0.03	1	365		2	70	730		1.1E-02		7.00E-05	1.6E+02	
Total PCBs (Immunological)	3.89	3.03	17.34	13.53	0.08	0.03	1	365	30		70		10,950		8.9E-03	2.00E-05		4.4E+02

Total Hazard Index = **1.6E+02** **4.4E+02**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.89	3.03	17.34	13.53	0.08	0.03	1	365	39	70	25,550	5.0E-03	2	9.9E-03

Excess Lifetime Risk = **9.9E-03**

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 6

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	2.85	0.11	1	365		2	70	730		4.5E-03		7.00E-05	6.4E+01	
Total PCBs (Immunological	3.66	2.85	0.11	1	365	30		70		10,950		4.5E-03	2.00E-05		2.2E+02

Total Hazard Index = **6.4E+01** **2.2E+02**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical -Specific Cancer Risk
Total PCBs	3.66	2.85	0.11	1	365	39	70	25,550	2.5E-03	2	5.0E-03

Excess Lifetime Cancer Risk = **5.0E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.66	2.85	8.28	6.46	0.08	0.03	1	365		2	70	730		5.9E-03		7.00E-05	8.4E+01	
Total PCBs (Immunological	3.66	2.85	8.28	6.46	0.08	0.03	1	365	30		70		10,950		5.9E-03	2.00E-05		3.0E+02

Total Hazard Index = **8.4E+01** **3.0E+02**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.66	2.85	8.28	6.46	0.08	0.03	1	365	39	70	25,550	3.3E-03	2	6.6E-03

Excess Lifetime Risk = **6.6E-03**

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 7

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	2.91	0.11	1	365		2	70	730		4.6E-03		7.00E-05	6.5E+01	
Total PCBs (Immunological	3.73	2.91	0.11	1	365	30		70		10,950		4.6E-03	2.00E-05		2.3E+02

Total Hazard Index = 6.5E+01 2.3E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	2.91	0.11	1	365	39	70	25,550	2.5E-03	2	5.1E-03

Excess Lifetime Cancer Risk = 5.1E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	3.73	2.91	6.40	4.99	0.08	0.03	1	365		2	70	730		5.4E-03		7.00E-05	7.7E+01	
Total PCBs (Immunological	3.73	2.91	6.40	4.99	0.08	0.03	1	365	30		70		10,950		5.4E-03	2.00E-05		2.7E+02

Total Hazard Index = 7.7E+01 2.7E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)$^{-1}$	Chemical Specific Cancer Risk
Total PCBs	3.73	2.91	6.40	4.99	0.08	0.03	1	365	39	70	25,550	3.0E-03	2	6.0E-03

Excess Lifetime Risk = 6.0E-03

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 8

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	3.27	0.11	1	365		2	70	730		5.1E-03		7.00E-05	7.3E+01	
Total PCBs (Immunological)	4.19	3.27	0.11	1	365	30		70		10,950		5.1E-03	2.00E-05		2.6E+02

Total Hazard Index = 7.3E+01 2.6E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	3.27	0.11	1	365	39	70	25,550	2.9E-03	2	5.7E-03

Excees Lifetime Cancer Risk = 5.7E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.19	3.27	9.60	7.49	0.08	0.03	1	365		2	70	730		6.6E-03		7.00E-05	9.7E+01	
Total PCBs (Immunological)	4.19	3.27	9.60	7.49	0.08	0.03	1	365	30		70		10,950		6.6E-03	2.00E-05		3.4E+02

Total Hazard Index = 9.7E+01 3.4E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	4.19	3.27	9.60	7.49	0.08	0.03	1	365	39	70	25,550	3.8E-03	2	7.6E-03

Excess Lifetime Risk = 7.6E-03

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 9

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.8	4.5	0.11	1	365		2	70	730		7.1E-03		7.00E-05	1.0E+02	
Total PCBs (Immunological	5.8	4.5	0.11	1	365	30		70		10,950		7.1E-03	2.00E-05		3.6E+02
													Total Hazard Index =	1.0E+02	3.6E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	5.8	4.5	0.11	1	365	39	70	25,550	4.0E-03	2	7.9E-03
										Excees Lifetime Cancer Risk =	7.9E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	5.8	4.5	6.50	5.07	0.08	0.03	1	365		2	70	730		7.3E-03		7.00E-05	1.0E+02	
Total PCBs (Immunological	5.8	4.5	6.50	5.07	0.08	0.03	1	365	30		70		10,950		7.3E-03	2.00E-05		3.7E+02
																Total Hazard Index =	1.0E+02	3.7E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Total Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	5.8	4.5	6.50	5.07	0.08	0.03	1	365	39	70	25,550	4.1E-03	2	8.2E-03
												Excess Lifetime Risk =		8.2E-03

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 10

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	1.89	0.11	1	365		2	70	730		3.0E-03		7.00E-05	4.2E+01	
Total PCBs (Immunological)	2.42	1.89	0.11	1	365	30		70		10,950		3.0E-03	2.00E-05		1.5E+02

Total Hazard Index = **4.2E+01** **1.5E+02**

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	1.89	0.11	1	365	39	70	25,550	1.7E-03	2	3.3E-03

Excees Lifetime Cancer Risk = **3.3E-03**

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	2.42	1.89	17.00	13.26	0.08	0.03	1	365		2	70	730		7.4E-03		7.00E-05	1.1E+02	
Total PCBs (Immunological)	2.42	1.89	17.00	13.26	0.08	0.03	1	365	30		70		10,950		7.4E-03	2.00E-05		3.7E+02

Total Hazard Index = **1.1E+02** **3.7E+02**

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	2.42	1.89	17.00	13.26	0.08	0.03	1	365	39	70	25,550	4.1E-03	2	8.3E-03

Excess Lifetime Risk = **8.3E-03**

Notes:
SMB = Small Mouth Bass species
CAR = Carp species
Immuno. = Immunological parameters
Repro. = Reproductive parameters

TABLE
SUBSISTENCE FISHING - MAXIMUM CONCENTRATIONS

ABSA 11

Small Mouth Bass - Non Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake (mg/kg-day)	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	3.35	0.11	1	365		2	70	730		5.3E-03		7.00E-05	7.5E+01	
Total PCBs (Immunological)	4.30	3.35	0.11	1	365	30		70		10,950		5.3E-03	2.00E-05		2.6E+02

Total Hazard Index = 7.5E+01 2.6E+02

Small Mouth Bass - Cancer (100% consumption of small mouth bass)

Chemical	Concentration of Chemcial in Raw Fish Fillet (mg/kg)	Concentration of Chemcial in Cooked Fish Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day	Oral Cancer Factor mg/kg-day)	Chemical Specific Cancer Risk
Total PCBs	4.30	3.35	0.11	1	365	39	70	25,550	2.9E-03	2	5.9E-03

Excees Lifetime Cancer Risk = 5.9E-03

Small Mouth Bass /Carp - Non Cancer (75% consumption of small mouth bass/ 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet (mg/kg)	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Immuno. Exposure Duration (years)	Repro. Exposure Duration (years)	Body Weight (kg)	Repro. Averaging Time (days)	Immuno. Averaging Time (days)	Repro. Fish Intake mg/kg-day	Immuno. Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Repro. Hazard Quotient	Immuno. Hazard Quotient
Total PCBs (Reproductive)	4.30	3.35	17.30	13.49	0.08	0.03	1	365	30	2	70	730		9.3E-03		7.00E-05	1.3E+02	
Total PCBs (Immunological)	4.30	3.35	17.30	13.49	0.08	0.03	1	365	30		70		10,950		9.3E-03	2.00E-05		4.6E+02

Total Hazard Index = 1.3E+02 4.6E+02

Small Mouth Bass /Carp - Cancer (75% consumption of small mouth bass / 25% consumption of carp)

Chemical	Concentration of Chemcial in Raw SMB Fillet (mg/kg)	Concentration of Chemcial in Cooked SMB Fillet (mg/kg)	Concentration of Chemcial in Raw CAR Fillet (mg/kg)	Concentration of Chemcial in Cooked CAR Fillet	SMB Ingestion Rate (kg/day)	CAR Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor (mg/kg-day)	Chemical Specific Cancer Risk
Total PCBs	4.30	3.35	17.30	13.49	0.08	0.03	1	365	39	70	25,550	5.2E-03	2	1.0E-02

Excess Lifetime Risk = 1.0E-02

Non Cancer - Residenti[illegible]rio
Floodplain Sediments - I[illegible]nd Average

Plainwell - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfD_{oral}	RfD_{inhal}	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	85,000	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.5E+00
Total PCB (Immunological)	85,000	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.0E+01

Plainwell - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	10,864	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.9E-01
Total PCB (Immunological)	10,864	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.6E+00

Otsego - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	36,000	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	8.1E-01
Total PCB (Immunological)	36,000	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	6.5E+00

Otsego - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	8,398	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.4E-01
Total PCB (Immunological)	8,398	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.0E+00

Non Cancer - Residenti[illegible]rio
Floodplain Sediments - [illegible]nd Average

Trowbridge - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	81,100	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.4E+00
Total PCB (Immunological)	81,100	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	1.9E+01

Trowbridge - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	12,308	1	350	245	350	2.78	7.52	353	1	0.14	1	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	2.1E-01
Total PCB (Immunological)	12,308	1	350	245	350	114	7.52	353	1	0.14	1	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.9E+00

Cancer - Residential &
Floodplain Sediments - [illegible] and Average

Plainwell - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AE_{inhal}	VF	PEF	$CSF_{o,d,inhalext}$	$CSF_{inhalvapor}$	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	(mg/m3-air/mg/kg-soil)	(mg/m3-air/mg/kg-soil)	(kg-day/mg)	(kg-day/mg)	(days)	(ug/kg)	
Total PCB	85,000	1	350	245	350	127	9.24	353	1	0.14	1	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	3.8E-04

Plainwell - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	10,864	1	350	245	350	127	9.24	353	1	0.14	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	4.8E-05

Otsego - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	36,000	1	350	245	350	127	9.24	353	1	0.14	1	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	1.6E-04

Otsego - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFI	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	8,398	1	350	245	350	127	9.24	353	1	0.14	1	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	3.7E-05

Cancer - Residential Sc.
Floodplain Sediments - Max and Average

Trowbridge - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	61,100	1	350	245	350	127	9.24	353	1	0.14	1	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	3.6E-04

Trowbridge - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	12,308	1	350	245	350	127	9.24	353	1	0.14	1	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	5.4E-05

Cancer Risk

CT Sport Angler

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.168	0.88
Carp	0.06	0.082	0.168	1.9

Sediment Concentration

	Bass	*Bass/Carp*
CT Sport	0.52	0.42

HE Sport Angler

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.083	0.88
Carp	0.06	0.082	0.083	1.9

Sediment Concentration

	Bass	*Bass/Carp*
HE Sport	0.257	0.207

Subsistence Angler

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.030	0.88
Carp	0.06	0.082	0.030	1.9

Sediment Concentration

	Bass	*Bass/Carp*
Subangler	0.093	0.075

Immunological Effects

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.300	0.88
Carp	0.06	0.082	0.300	1.9

Sediment Concentration

	Bass	*Bass/Carp*
CT Sport	0.93	0.75

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.192	0.88
Carp	0.06	0.082	0.192	1.9

Sediment Concentration

	Bass	*Bass/Carp*
HE Sport	0.60	0.48

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.065	0.88
Carp	0.06	0.082	0.065	1.9

Sediment Concentration

	Bass	*Bass/Carp*
Subangler	0.203	0.164

Reproductive Effects

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	1.04	0.88
Carp	0.06	0.082	1.04	1.9

Sediment Concentration

	Bass	*Bass/Carp*
CT Sport	3.23	2.61

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.635	0.88
Carp	0.06	0.082	0.635	1.9

Sediment Concentration

	Bass	*Bass/Carp*
HE Sport	1.97	1.59

	% Lipid	TOC	Conc fish	BSAF
Bass	0.03	0.082	0.225	0.88
Carp	0.06	0.082	0.225	1.9

Sediment Concentration

	Bass	*Bass/Carp*
Subangler	0.70	0.57

Calculation of Risk Based Sediment Concentration Protective of Ingestion of Fish by Central Tendency Sport Anglers

Concentration in Small Mouth Bass (CF) - Non Cancer (Consumption of small mouth bass and carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole-Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Sport Exposure Duration (years)	Reproductive Exposure Duration (years)	Body Weight (kg)	Reproductive Averaging Time (days)	Sport Averaging Time (days)	Reproductive Fish Intake (mg/kg-day)	Sport Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Reproductive Hazard Quotient	Sport Hazard Quotient
Total PCBs (Immunological)	0.30	0.075	0.015	1	365	9		70		3,285		1.61E-05	2.00E-05		8.0E-01
Total PCBs (Reproductive)	1.04	0.26	0.015	1	365		2	70	730		5.6E-05		7.00E-05	8.0E-01	
												Total Hazard Index =		**8.0E-01**	**8.0E-01**

Concentration in Small Mouth Bass (CF) - Cancer (Consumption of small mouth bass nd carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole-Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.168	0.042	0.015	1	365	39	70	25,550	5.0E-06	2	1.0E-05
									Excess Lifetime Cancer Risk =		**1.0E-05**

Calculation of Risk Based Sediment Concentration Protective of Ingestion of Fish by High End Sport Anglers

Concentration in Small Mouth Bass (CF) - Non Cancer (Consumption of small mouth bass and carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	PCB Concentration in Cooked Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Sport Exposure Duration (years)	Reproductive Exposure Duration (years)	Body Weight (kg)	Reproductive Averaging Time (days)	Sport Averaging Time (days)	Reproductive Fish Intake (mg/kg-day)	Sport Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Reproductive Hazard Quotient	Sport Hazard Quotient
Total PCBs (Immunological)	0.192	0.048	0.037	0.078	0.5	365	9		70		3,285		2.09E-05	2.00E-05		1.0E+00
Total PCBs (Reproductive)	0.635	0.159	0.124	0.078	0.5	365		2	70	720		7.0E-05		7.00E-05	1.0E+00	
														Total Hazard Index =	1.0E+00	1.0E+00

Concentration in Small Mouth Bass (CF) - Cancer (Consumption of small mouth bass and carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	PCB Concentration in Cooked Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.083	0.021	0.016	0.078	0.5	365	39	70	25,550	5.0E-06	2	1.0E-05
									Excess Lifetime Cancer Risk =			1.0E-05

Calculation of Risk Based Sediment Concentration Protective of Ingestion of Fish by Subsistence Anglers

Concentration in Small Mouth Bass (CF) - Non Cancer (Consumption of small mouth bass and carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	PCB Concentration in Cooked Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Subsistence Exposure Duration (years)	Reproductive Exposure Duration (years)	Body Weight (kg)	Reproductive Averaging Time (days)	Subsistence Averaging Time (days)	Reproductive Fish Intake (mg/kg-day)	Subsistence Fish Intake (mg/kg-day)	Chronic RfD (mg/kg-day)	Reproductive Hazard Quotient	Subsistence Hazard Quotient
Total PCBs (Immunological)	0.065	0.016	0.013	0.11	1	365	30		70		10,950		2.0E-05	2.00E-05		1.0E+00
Total PCBs (Reproductive)	0.225	0.056	0.044	0.11	1	365		2	70	720		7.0E-05		7.00E-05	1.0E+00	
														Total Hazard Index =	1.0E+00	1.0E+00

Concentration in Small Mouth Bass (CF) - Cancer (Consumption of small mouth bass and carp)

Chemical	PCB Concentration in Raw Small Mouth Bass Whole Body (mg/kg)	PCB Concentration in Raw Small Mouth Bass Fillet (mg/kg)	PCB Concentration in Cooked Small Mouth Bass Fillet (mg/kg)	Ingestion Rate (kg/day)	Fraction Ingested (unitless)	Exposure Frequency (days/year)	Exposure Duration (years)	Body Weight (kg)	Averaging Time (days)	Fish Intake (mg/kg-day)	Oral Cancer Factor $(mg/kg\text{-}day)^{-1}$	Chemical Specific Cancer Risk
Total PCBs	0.030	0.008	0.0059	0.11	1	365	39	70	25,550	5.1E-06	2	1.0E-05
									Excess Lifetime Cancer Risk =			1.E-05

Non Cancer - Recreation, arlo
Floodplain Sediments - Max and Average

Plainwell - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfD_{oral}	RfD_{inhal}	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	85,000	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.6E-01
Total PCB (Immunological)	85,000	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.1E+00

Plainwell - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	10,864	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	2.1E-02
Total PCB (Immunological)	10,864	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.7E-01

Otsego - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	36,000	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	6.8E-02
Total PCB (Immunological)	36,000	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	9.0E-01

Otsego - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFI	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	8,398	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.6E-02
Total PCB (Immunological)	8,398	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.1E-01

Non Cancer - Recreation[illegible]io
Floodplain Sediments - Maximum Average

Trowbridge - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	81,100	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	1.5E-01
Total PCB (Immunological)	81,100	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	2.0E+00

Trowbridge - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	RfDo	RfDi	AT	CF	Hazard Quotient
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	mg/m3-air/mg/kg-soil	(mg/kg-day	(mg/kg-day)	(days)	(ug/kg)	
Total PCB (Reproductive)	12,308	1	128	128	128	2.78	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	7.0E-05	7.0E-05	10,950	1.0E+09	2.3E-02
Total PCB (Immunological)	12,308	1	128	128	128	34	1.40	61	1	0.14	0.47	7.3E-07	6.9E-12	2.0E-05	2.0E-05	10,950	1.0E+09	3.1E-01

Cancer - Recreational
Floodplain Sediments - Max and Average

Plainwell - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AE_{inhal}	VF	PEF	$CSF_{o,d,inhalvapor}$	$CSF_{inhalvapor}$	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	(mg/m3-air/mg/kg-soil)	(mg/m3-air/mg/kg-soil)	(kg-day/mg)	(kg-day/mg)	(days)	(ug/kg)	
Total PCB	85,000	1	128	128	128	47	1.90	85	1	0.14	0.47	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	5.0E-05

Plainwell - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	10,864	1	128	128	128	47	1.90	85	1	0.14	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	6.4E-06

Otsego - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	36,000	1	128	128	128	47	1.90	85	1	0.14	0.47	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	2.1E-05

Otsego - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	8,396	1	128	128	128	47	1.90	85	1	0.14	0.47	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	5.0E-06

Cancer - Recreational - Trowbridge
Floodplain Sediments - Max and Average

Trowbridge - Maximum
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	81,100	1	128	128	128	47	1.90	85	1	0.14	0.47	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	4.8E-05

Trowbridge - Average
Floodplain Sediments
Ingestion of Soil, DermalContact with Soil and Inhalation of Particulates

Chemical	C	FC	EFi	EFd	EFinhal	IRsoil	IRair	DF	AEi	AEd	AEinhal	VF	PEF	CSFo	CSFi	AT	CF	Cancer Risk
	(µg/kg)	(unitless)	(days/yr)	(days/yr)	(days/yr)	(mg-yr/kg-day)	(m^3-yr/kg-day)	(mg-yr/kg-day)	(unitless)	(unitless)	(unitless)	mg/m3-air/mg/kg-soil	(mg/m3-air/mg/kg-soil)	(mg/kg-day)	(mg/kg-day)	(days)	(ug/kg)	
Total PCB	12,308	1	128	128	128	47	1.90	85	1	0.14	0.47	7.3E-07	6.9E-12	2.0E+00	4.0E-01	25,550	1.0E+09	7.3E-06

Appendix B
US Fish and Wildlife Data

Based on these results, the entire Saugatuck carp data base for the years 1981, 1983, 1985 and 1986 and the Saugatuck bass data base for the years 1981 and 1985 was analyzed using the Kruskal-Wallis non-parametric test. This analysis again found that no significant ($p = 0.05$) difference between years at this location for either species.

This indicates that there was no change in PCB concentrations in fish at Saugatuck during the 1981-86 time period.

4.2.5 Waterfowl

Waterfowl have been sampled in the Area of Concern in 1985 and 1986 by the United States Fish and Wildlife Service. In 1985, eight immature mallards, one adult mallard and one adult wood duck were analyzed for PCB. The birds were plucked, eviscerated and feet removed prior to analyses. PCB concentrations ranged from 0.25 to 1.9 mg/kg (Table 8). Converting these values to a fat basis, PCB values ranged from 2.7 to 700 ppm. All of the immature ducks collected exceeded the FDA action level of 3 ppm PCB on a fat basis.

In 1986, mute swan eggs were collected as part of the effort to reintroduce the trumpeter swan. The eggs were from the Allegan State Game Area in the vicinity of the Kalamazoo River. Fourteen eggs were anlyzed for PCBs. Concentrations ranged from 0.1 to 1.6 mg/kg with a mean concentration of 0.4 mg/kg (Table 9). This mean concentration is greater than the FDA action level for eggs (0.3 mg/kg).

From: Kalamazoo River Remedial Action Plan
MDNR, 1987

TABLE 8. PCB LEVELS IN WATERFOWL COLLECTED FROM THE KALAMAZOO RIVER, AUGUST, 1985

LOCATION	SPECIES	MATURITY	PCB AS 1260 (MG/KG)
MORROW POND	MERGANSER	ADULT	28.00
OTSEGO CITY IMPOUNDMENT	MALLARD	ADULT	4.80
	MALLARD	IMMATURE	2.00
	BLUEWINGED TEAL	IMMATURE	<0.25
TROWBRIDGE IMPOUNDMENT	MALLARD	IMMATURE	1.90
	MALLARD	IMMATURE	0.73
ALLEGAN STATE GAME AREA	WOOD DUCK	IMMATURE	1.50
	CANADA GOOSE	IMMATURE	<0.25
SAUGATUCK	MALLARD	IMMATURE	0.78
	MALLARD	IMMATURE	<0.25
	MALLARD	IMMATURE	<0.25
	MALLARD	IMMATURE	0.60
	MALLARD	IMMATURE	1.70
	MALLARD	IMMATURE	0.55
	MALLARD	IMMATURE	1.90
	MALLARD	IMMATURE	1.04
	MALLARD	ADULT	0.98
	WOOD DUCK	ADULT	<0.25

$3\overline{)34.34} = 2.0$

Catalog No.: _____
Study I.D. No.: 89-3-002 TITLE: MICHIGAN WATERFOWL CONTAMINANTS SURVEY 53

Analyze all samples for the compounds specified under analyses requested.
Numbers in parenthesis refer to Michigan DNR Wildlife Region

Sample NO	Common name	Matrix	Sample Type	Sample Location	Sample Wt.(g)	Analyses Requested
WPL-1A	Mallard	Breast/skin	Individual	Kalamazoo River(8)	120.77	OCs, Hg
WPL-1B	Mallard	Breast	Individual	Kalamazoo River	98.95	OCs, Hg
WPL-4A	Mallard	Breast/skin	Individual	Potawatomie Marsh	111.75	OCs, Hg
WPL-4B	Mallard	Breast	Individual	Potawatomie Marsh	89.27	OCs, Hg
WPL-5A	Mallard	Breast	Individual	Potawatomie Marsh	66.45	OCs, Hg
WPL-5B	Mallard	Breast	Individual	Potawatomie Marsh	63.32	OCs, Hg
WPL-6A	Mallard	Breast/skin	Individual	Potawatomie Marsh	68.62	OCs, Hg
WPL-6B	Mallard	Breast	Individual	Potawatomie Marsh	75.29	OCs, Hg
WPL-7A	Mallard	Breast/skin	Individual	Potawatomie Marsh	66.32	OCs, Hg
WPL-8A	Mallard	Breast/skin	Individual	Potawatomie Marsh	90.92	OCs, Hg
WPL-8B	Mallard	Breast	Individual	Potawatomie Marsh	92.56	OCs, Hg
WPL-16A	Mallard	Breast/skin	Individual	Maple River(7)	83.31	OCs, Hg
WPL-16B	Mallard	Breast	Individual	Maple River	64.82	OCs, Hg
WPL-17A	Mallard	Breast/skin	Individual	Maple River	76.61	OCs, Hg
WPL-17B	Mallard	Breast	Individual	Maple River	72.01	OCs, Hg
WPL-23A	Mallard	Breast/skin	Individual	Shiawassee River	105.80	OCs, Hg
WPL-23B	Mallard	Breast	Individual	Shiawassee River	73.00	OCs, Hg
WPL-24A	Mallard	Breast/skin	Individual	Shiawassee River	78.93	OCs, Hg
WPL-24B	Mallard	Breast	Individual	Shiawassee River	70.82	OCs, Hg
WPL-25A	Mallard	Breast/skin	Individual	Shiawassee River	68.14	OCs, Hg
WPL-25B	Mallard	Breast	Individual	Shiawassee River	66.20	OCs, Hg
WPL-27A	Mallard	Breast/skin	Individual	Shiawassee River	91.48	OCs, Hg
WPL-47A	Mallard	Breast/skin	Individual	Saginaw Bay (1) (Nayanquin Pt)	68.35	OCs, Hg
WPL-48A	Mallard	Breast/skin	Individual	Nayanquin Pt	47.79	OCs, Hg
WPL-49A	Mallard	Breast/skin	Individual	Nayanquin Pt	111.60	OCs, Hg
WPL-49B	Mallard	Breast	Individual	Nayanquin Pt	73.60	OCs, Hg
WPL-50A	Mallard	Breast/skin	Individual	Nayanquin Pt	91.43	OCs, Hg
WPL-50B	Mallard	Breast	Individual	Nayanquin Pt	72.45	OCs, Hg
WPL-56A	Mallard	Breast/skin	Individual	(Fish Pt.)	61.41	OCs, Hg
WPL-57A	Mallard	Breast/skin	Individual	(Wild Fowl Bay)	88.41	OCs, Hg
WPL-57B	Mallard	Breast	Individual	Wild Fowl Bay	93.25	OCs, Hg
WPL-58A	Mallard	Breast/skin	Individual	(Fish Pt.)	82.17	OCs, Hg
WPL-59A	Mallard	Breast/skin	Individual	Fish Pt.	66.40	Ocs, Hg
WPL-59B	Mallard	Breast	Individual	Fish Pt.	63.07	OCs, Hg
WPL-60A	Mallard	Breast/skin	Individual	Fish Pt.	78.06	OCs, Hg
WPL-60B	Mallard	Breast	Individual	Fish Pt.	72.35	OCs, Hg
WPL-67A	Mallard	Breast	Individual	Reedsburg Flood(11)	70.88	OCs, Hg
WPL-69A	Mallard	Breast	Individual	Mud Lake	74.72	OCs, Hg
WPL-70A	Mallard	Breast	Individual	Houghton Lake	81.01	OCs, Hg
WPL-126A	Mallard	Breast/skin	Individual	Harsens Is. (3)	135.05	OCs, Hg
WPL-127A	Mallard	Breast/skin	Individual	Harsens Is.	108.18	OCs, Hg
WPL-128A	Mallard	Breast/skin	Individual	Harsens Is.	109.31	OCs, Hg
WPL-129A	Mallard	Breast/skin	Individual	Harsens Is.	98.31	OCs, Hg
WPL-130A	Mallard	Breast/skin	Individual	Harsens Is.	81.51	OCs, Hg
WPL-131A	Mallard	Breast/skin	Individual	Harsens Is.	118.47	OCs, Hg
WPL-132A	Mallard	Breast/skin	Individual	Harsens Is.	89.66	OCs, Hg
WPL-132B	Mallard	Breast	Individual	Harsens Is.	100.06	OCs, Hg
WPL-133A	Mallard	Breast/skin	Individual	Harsens Is.	115.43	OCs, Hg
WPL-133B	Mallard	Breast	Individual	Harsens Is.	96.47	OCs, Hg
WPL-134A	Mallard	Breast/skin	Individual	Harsens Is.	82.87	OCs, Hg
WPL-134B	Mallard	Breast	Individual	Harsens Is.	92.51	OCs, Hg
WPL-135A	Mallard	Breast/skin	Individual	Harsens Is.	121.02	OCs, Hg
WPL-135B	Mallard	Breast	Individual	Harsens Is.	99.96	OCs, Hg

E TYPE: Malla.
st/skin

NO 5851
ATCH NO. 89-3-002
RDER NO. 85800-89-08008

MISSISSIPPI STATE CHEMICAL LABORATORY
BOX CR
MISSISSIPPI STATE, MS 39762
REPORT FORM
USDI/FWS

ORGANOCHLORINES

DATE RECEIVED 01/12/90

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	WPL-1A	WPL-1B	WPL-4A	WPL-4B	WPL-5A	WPL-5B	WPL-6A
LAB #	784228	784229	784230	784231	784232	784233	784234
MATRIX	Mallard Bre./skin	Mallard Breast	Mallard Bre./skin	Mallard Breast	Mallard Breast	Mallard Breast	Mallard Bre./Skin
COMPOUND							
HCB	ND*	ND	ND	ND	ND	ND	ND
α-BHC	ND	ND	ND	ND	ND	ND	ND
γ-BHC	ND	ND	ND	ND	ND	ND	ND
β-BHC	ND	ND	ND	ND	ND	ND	ND
δ-BHC	ND	ND	ND	ND	ND	ND	ND
Oxychlordane	ND	ND	ND	ND	ND	ND	ND
Hept. Epox.	ND	ND	ND	ND	ND	ND	ND
γ-Chlordane	ND	ND	ND	ND	ND	ND	ND
t-Nonachlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
PCB's (total)	0.29	ND	ND	ND	ND	ND	ND
o, p'-DDE	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	ND	ND	ND	ND	ND	ND
p, p'-DDE	0.01	ND	0.07	0.01	ND	ND	0.01
Dieldrin	ND	ND	ND	ND	ND	ND	ND
o, p'-DDD	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
cis-nonachlor	ND	ND	ND	ND	ND	ND	ND
o, p'-DDT	ND	ND	ND	ND	ND	ND	ND
p, p'-DDD	ND	ND	ND	ND	ND	ND	ND
p, p'-DDT	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	120	97.2	111	86.8	65.8	59.3	68.5
MOISTURE (%)	72.5	73.5	69.0	73.0	67.0	71.5	67.5
LIPID (%)	3.75	1.75	8.60	2.35	6.45	2.25	8.60

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs.
For Water, LLD= 0.005 ppm for OCs, Tox , PCBs
**Spike = ppm for
= Confirmed by GC/Mass Spectrometry
*ND = None Detected
***NS = Not Spiked

Signature

TYPE: Mallard
./skin

NO. 5851
CH NO. 89-3-002
DER NO. 85800-89-08008

MISSISSIPPI STATE CHEMICAL LABORATORY
BOX CR
MISSISSIPPI STATE, MS 39762
REPORT FORM
USDI/FWS

ORGANOCHLORINES

DATE RECEIVED 01/12/90

PARTS PER MILLION AS RECEIVED (WET WT)

FWS #	WPL-6B	WPL-7A	WPL-8A	WPL-8B	WPL-8B	WPL-16A	WPL-16B
LAB #	784235	784236	784237	784238A	784238B	784239	784240
MATRIX	Mallard Breast	Mallard Bre./skin	Mallard Bre./skin	Mallard Breast	Duplicate Ma.Breast	Mallard Bre./skin	Mallard Breast
COMPOUND							
HCB	ND*	ND	ND	ND	ND	ND	ND
α-BHC	ND	ND	ND	ND	ND	ND	ND
γ-BHC	ND	ND	ND	ND	ND	ND	ND
β-BHC	ND	ND	ND	ND	ND	ND	ND
δ-BHC	ND	ND	ND	ND	ND	ND	ND
Oxychlordane	ND	ND	ND	ND	ND	ND	ND
Hept. Epox.	ND	ND	ND	ND	ND	ND	ND
γ-Chlordane	ND	ND	ND	ND	ND	ND	ND
t-Nonachlor	ND	ND	ND	ND	ND	ND	ND
Toxaphene	ND	ND	ND	ND	ND	ND	ND
PCB's (total)	ND	ND	ND	ND	ND	ND	ND
o, p'-DDE	ND	ND	ND	ND	ND	ND	ND
α-Chlordane	ND	ND	ND	ND	ND	ND	ND
p, p'-DDE	ND	ND	0.01	ND	ND	0.01	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND
o, p'-DDD	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND
cis-nonachlor	ND	ND	ND	ND	ND	ND	ND
o, p'-DDT	ND	ND	ND	ND	ND	ND	ND
p, p'-DDD	ND	ND	ND	ND	ND	ND	ND
p, p'-DDT	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND
OTHER:							
WEIGHT (g)	75.0	63.7	90.8	92.1	92.1	81.6	64.1
MOISTURE (%)	73.0	69.5	70.5	73.0	73.0	66.5	70.5
LIPID (%)	1.95	5.25	4.60	2.40	2.30	8.70	2.80

Lower Level of Detection = 0.01 ppm for Tissue, Soil, Etc. 0.05 for Toxaphene and PCBs.
For Water, LLD= 0.005 ppm for OCs, Tox , PCBs
**Spike = ppm for
= Confirmed by GC/Mass Spectrometry
*ND = None Detected
***NS = Not Spiked

Larry Lane
Signature

Appendix C

Comparison of Lower Fox River and API/PC/KR Exposure Concentrations

Comparison of Lower Fox River and API / PC / KR Exposure Concentrations and Results of Risk /Hazard Scaling
Changes from Outside Review

RME : Reasonable Maximum Exposure (represents high - end exposure)
CTE : Central tendency Exposure (represents more typical exposure)

For calculation of EPC : two calculations were performed
1) Upper bound measured concentration - the lower of the 95% UCL on the arithmetic mean or the max. detected conc. (whichever is lower)
2) Average measured concentration - arithmetic mean
3) For CDM estimated risk calculations are based on : CDM maximum = FR RME Upperbound concentration and risk ; CDM average = FR CTE average conc. and risk

Pathway	Fox River Statistical Analysis	Risk [2]	Fox River PCB Conc. [1]	Units	Exceeded Cancer Risk / HI	Area	Kalamazoo Stat. Analysis	Kalamazoo PCB Conc. [1]	Units	Estimated Kalamazoo Risk	Exceeded Cancer Risk / HI
rec. angler											
ingestion of fish	Cancer RME - Upperbound Conc.	4.4E-03	5.783	mg/kg	Y	Green Bay	maximum	17.34	mg/kg	1.32E-02	Y
	Cancer RME - Average Conc.	2.8E-03	3.664	mg/kg	Y	Green Bay	average	7.6	mg/kg	8.92E-04	Y
	Cancer CTE - Average Conc.	4.3E-04	3.664	mg/kg	Y	Green Bay					
	NonCancer RME - Upperbound Conc.	1.2E+02	5.783	mg/kg	Y	Green Bay	maximum	17.34	mg/kg	3.74E+02	Y
	NonCancer RME - Average Conc.	8.4E+01	3.975	mg/kg	Y	Appleton to Ltl. Rapids	average	7.6	mg/kg	4.09E+01	Y
	NonCancer CTE - Average Conc.	2.1E+01	3.975	mg/kg	Y	Appleton to Ltl. Rapids					
ingestion/dermal contact w/surface water	Cancer RME - Upperbound Conc.	1.2E-07	2.41E-05	mg/L		DePere to GB	maximum	7.10E-05		3.54E-07	
	Cancer RME - Average Conc.	1.0E-07	2.16E-05	mg/L		DePere to GB	median	2.50E-05		1.16E-07	
	Cancer CTE - Average Conc.	1.7E-08	2.16E-05	mg/L		DePere to GB					
	NonCancer RME - Upperbound Conc.	6.0E-03	1.44E-05	mg/L		Ltl. Lake Buttes des Morts	maximum	7.10E-05		2.95E-02	
	NonCancer RME - Average Conc.	5.0E-03	1.11E-05	mg/L		Ltl. Rapids to De Pere	median	2.50E-05		2.25E-03	
	NonCancer CTE - Average Conc.	1.0E-03	1.11E-05	mg/L		Ltl. Rapids to De Pere					
No Sediment since anglers assumed to be wearing boots - covered in wader scenario											
subsistence angler											
ingestion of fish	Cancer RME - Upperbound Conc.	6.00E-03	5.783	mg/kg	Y	Green Bay	maximum	17.34	mg/kg	1.80E-02	Y
	Cancer RME - Average Conc.	3.80E-03	3.664	mg/kg	Y	Green Bay	average	7.6	mg/kg	1.24E-03	Y
	Cancer CTE - Average Conc.	6.00E-04	3.664	mg/kg	Y	Green Bay					
	NonCancer RME - Upperbound Conc.	1.7E+02	5.783	mg/kg	Y	Green Bay	maximum	17.34	mg/kg	5.12E+02	Y
	NonCancer RME - Average Conc.	1.2E+02	3.975	mg/kg	Y	Appleton to Ltl. Rapids	average	7.6	mg/kg	5.77E+01	Y
	NonCancer CTE - Average Conc.	3.0E+01	3.975	mg/kg	Y	Appleton to Ltl. Rapids					
ingestion/dermal contact w/surface water	Cancer RME - Upperbound Conc.	1.6E-07	2.41E-05			DePere to Green Bay	maximum	7.10E-05	mg/L	4.72E-07	
	Cancer RME - Average Conc.	1.6E-07	2.16E-05			DePere to Green Bay	median	2.50E-05	mg/L	2.78E-08	
	Cancer CTE - Average Conc.	2.4E-08	2.16E-05			DePere to Green Bay					
	NonCancer RME - Upperbound Conc.	8.0E-03	1.44E-05			Little Lake Butte des Mort	maximum	7.10E-05	mg/L	3.94E-02	
	NonCancer RME - Average Conc.	6.0E-03	9.20E-06			Little Rapids to DePere	median	2.50E-05	mg/L	5.44E-03	
	NonCancer CTE - Average Conc.	2.0E-03	9.20E-06			Little Rapids to DePere					
No Sediment since anglers assumed to be wearing boots - covered in wader scenario											
Hunter											
ingestion of waterfowl	Cancer RME - Upperbound Conc.	1.1E-04	1.7	mg/kg	Y	Little Rapids to DePere	maximum	700	mg/kg	4.53E-02	Y
	Cancer RME - Average Conc.	4.7E-05	0.424	mg/kg	Y	Green Bay	average	59.3	mg/kg	1.96E-03	Y
	Cancer CTE - Average Conc.	1.4E-05	0.424	mg/kg	Y	Green Bay					
	NonCancer RME - Upperbound Conc.	4.3E+00	1.7	mg/kg	Y	Little Rapids to DePere	maximum	700	mg/kg	1.77E+03	Y
	NonCancer RME - Average Conc.	1.4E+00	0.541	mg/kg	Y	Appleton to Little Rapids	average	59.3	mg/kg	7.56E+01	Y
	NonCancer CTE - Average Conc.	6.9E-01	0.541	mg/kg		Appleton to Little Rapids					
ingestion/dermal contact w/surface water	Cancer RME - Upperbound Conc.	1.50E-08	2.41E-05			DePere to Green Bay	maximum	7.10E-05	mg/L	4.42E-08	
	Cancer RME - Average Conc.	1.50E-08	2.16E-05			DePere to Green Bay	median	2.50E-05	mg/L	4.97E-09	
	Cancer CTE - Average Conc.	4.30E-09	2.16E-05			DePere to Green Bay					
	NonCancer RME - Upperbound Conc.	1.00E-03	1.44E-05			Little Lake Butte des Morts	maximum	7.10E-05	mg/L	4.92E-03	
	NonCancer RME - Average Conc.	1.00E-03	1.11E-05			Little Rapids to DePere	median	2.50E-05	mg/L		

Pathway	Fox River Statistical Analysis	Risk [5]	Fox River PCB Conc. [11]	Units	Exceeded Cancer Risk / HI	Area	Kalamazoo Stat. Analysis	Kalamazoo PCB Conc. [11]	Units	Estimated Kalamazoo Risk	Exceeded Cancer Risk / HI
	NonCancer CTE - Average Conc.	0	---			---					
Local Resident											
inhalation of indoor/outdoor air	Cancer RME - Upperbound Conc.	1.80E-07	2.40E-05	mg/L		DePere to Green Bay	maximum	1.20E-04	mg/L	9.00E-07	
	Cancer RME - Average Conc.	not looked at	---			---	average	7.50E-05	mg/L		
	Cancer CTE - Average Conc.	not looked at	---			---	95% UCL	1.00E-04	mg/L		
	NonCancer RME - Upperbound Conc.	3.80E+00	1.44E-05	mg/L	Y	Little Lake Butte des Mortes	maximum	1.20E-04	mg/L	3.16E+01	Y
	NonCancer RME - Average Conc.	not looked at	---			---	average	7.50E-05	mg/L		
	NonCancer CTE - Average Conc.	not looked at	---			---	95% UCL	1.00E-04	mg/L		
recreational swimmer											
ingestion/dermal contact w/surface water	Cancer RME - Upperbound Conc.	6.80E-08	2.41E-05	mg/L		DePere to Green Bay	maximum	7.10E-05	mg/L	2.00E-07	
	Cancer RME - Average Conc.	not looked at	---				median	2.50E-05	mg/L		
	Cancer CTE - Average Conc.	not looked at	---								
	NonCancer RME - Upperbound Conc.	1.40E-02	2.41E-05	mg/L		DePere to Green Bay	maximum	7.10E-05	mg/L	4.13E-02	
	NonCancer RME - Average Conc.	not looked at	---				median	2.50E-05	mg/L		
	NonCancer CTE - Average Conc.	not looked at	---								
ingestion/dermal contact w/sediment	Cancer RME - Upperbound Conc.	8.70E-08	5.527	mg/kg		Little Lake Butte des Mortes	maximum	156	mg/kg		
	Cancer RME - Average Conc.	not looked at	---				average	3.7	mg/kg	5.82E-08	
	Cancer CTE - Average Conc.	not looked at	---				95% UCL	13.6	mg/kg	2.14E-07	
	NonCancer RME - Upperbound Conc.	2.5E-02	5.527	mg/kg		Little Lake Butte des Mortes	maximum	156	mg/kg		
	NonCancer RME - Average Conc.	not looked at	---				average	3.7	mg/kg	1.67E-02	
	NonCancer CTE - Average Conc.	not looked at	---				95% UCL	13.6	mg/kg	6.15E-02	
occupational worker											
ingestion/dermal contact w/surface water	Cancer RME - Upperbound Conc.	7.80E-09	2.41E-05	mg/L		DePere to Green Bay	maximum	7.10E-05	mg/L	2.30E-08	
	Cancer RME - Average Conc.	not looked at	---				median	2.50E-05	mg/L		
	Cancer CTE - Average Conc.	not looked at	---								
	NonCancer RME - Upperbound Conc.	2.0E-03	1.44E-05	mg/L		Little Lake Butte des Mortes	maximum	7.10E-05	mg/L	9.84E-03	
	NonCancer RME - Average Conc.	not looked at	---				median	2.50E-05	mg/L		
	NonCancer CTE - Average Conc.	not looked at	---								
ingestion/dermal contact w/sediment	Cancer RME - Upperbound Conc.	1.90E-07	5.527	mg/kg		Little Lake Butte des Mortes	maximum	156	mg/kg		
	Cancer RME - Average Conc.	not looked at	---				average	3.7	mg/kg	1.27E-07	
	Cancer CTE - Average Conc.	not looked at	---				95% UCL	13.6	mg/kg	4.68E-07	
	NonCancer RME - Upperbound Conc.	2.50E-02	5.527	mg/kg		Little Lake Butte des Mortes	maximum	156	mg/kg		
	NonCancer RME - Average Conc.	not looked at	---				average	3.7	mg/kg	1.67E-02	
	NonCancer CTE - Average Conc.	not looked at	---				95% UCL	13.6	mg/kg	6.15E-02	

Appendix D
Toxicity Profile

Appendix D
Toxicity Profile for Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) are a group of synthetic organic chemicals consisting of 209 individual compounds, or congeners. A congener may have between 1 and 10 chlorine atoms located at various positions on the PCB molecule. Monochlorobiphenyls have one chlorine atom per molecule; dichlorobiphenyls have two chlorine atoms per molecule. This pattern progresses up through decachlorobiphenyls with ten chlorine atoms per molecule.

There are no known natural sources of PCBs. Before 1977, PCBs entered the water, air and soil during their manufacture and use. PCBs also entered the environment as a result of spills, leaks or fires in capacitors or transformers containing PCBs. PCBs can enter the environment today through poorly maintained hazardous waste sites, illegal or improper dumping of wastes, or disposal of PCB-containing consumer products into municipal landfills not designed to handle hazardous waste. Municipal and industrial incinerators that burn organic wastes can also release PCBs into the environment (ATSDR, 1998).

PCBs were used extensively in the United States from the 1930's through 1977, when the manufacture of PCBs was banned. PCBs mixtures have several chemical and physical properties which made them useful in a variety of industrial applications including resistance to acids and bases as well as oxidation and reduction; compatibility with organic materials; and thermal stability and nonflammability. The major uses of PCBs were as dielectric fluids in capacitors and transformers; as additives in paint, plastics, newspaper print, and dyes; as extenders in pesticides; and as heat transfer and hydraulic fluids (Kimbrough et al. 1999).

People may be exposed to PCBs from the workplace and from the environment. Exposures occur through contact with air, water, soil, breast milk, and food. Exposure can also occur in utero. The primary pathway of exposure to PCBs in the Great Lakes region is through the food pathway, particularly through the consumption of fish (ATSDR, 1998). Susceptible populations include certain ethnic groups, sport anglers, the elderly, pregnant women, children, fetuses and nursing infants.

Summary of Health Effects Associated with PCBs - Human Health Studies

The Agency for Toxic Substances and Disease Registry (ATSDR) and the U.S. Environmental Protection Agency (EPA) have jointly developed a technical paper, Public Health Implications of Polychlorinated Biphenyls (PCBs) Exposure. Human health studies discussed in this paper indicate that exposure to PCBs have been linked to the following health effects:

- Reproductive function in women
- Neurobehavioral and development deficits in newborns and school-age children from in utero exposure
- Liver disease, immune function impacts, and thyroid effects
- Increased cancer risks

Several studies have demonstrated a correlation between fish consumption by mothers and developmental disorders and cognitive deficits in children. In the first of these studies, conducted by Jacobson (Jacobson et. al. 1985, 1990a, 1990b, 1996), statistically significant decreases in gestational age, birth weight, and head circumference were observed and continued to be evident 5 to 7 months after birth. Neurobehavioral deficits were observed including depressed responsiveness, impaired visual recognition, and poor short-term memory at 7 months of age, which continued to be present at 4 years of age. While recognized limitations exist in these studies, including the pooling of blood samples, which is no longer a recognized technique, more recent studies have provided confirmatory evidence of the relationship between PCB exposure and developmental effects.

In a study of prenatal exposure and neonatal behavioral assessment scale (NBAS) performance, cord blood PCBs, DDE, HCB, Mirex, lead and hair mercury levels were determined for 152 women who reported never consuming Lake Ontario fish and 141 women who reported consuming at least 40 PCB-equivalent lbs. of Lake Ontario Fish over a lifetime. PCBs were related to impaired performance on those NBAS clusters associated with fish consumption, namely, Habituation and Autonomic clusters. Results revealed significant linear relationships between the most heavily chlorinated PCBs and performance impairments 25 - 48 hours after birth. Higher prenatal PCB exposure was also associated with nonspecific performance impairment (Stewart, et al. 2000). PCBs of lighter chlorination were unrelated to NBAS performance.

Studies in Japan and Taiwan of PCB exposure from consumption of contaminated rice oil have contributed to the evidence of an association between PCBs and neurobehavioral effects. The illnesses were originally referred to as Yusho disease in Japan and Yu-Cheng disease in Taiwan. In earlier studies (Bandiera et al., 1984; Kunita et al.; Masuda and Yoshimura 1984; Ryan et al. 1990; ATSDR 1993) co-contaminants in the rice oil, particularly chlorinated dibenzofurans (CDFs), were considered to be the primary causal agent. Recent studies, however, involving a re-examination of previous studies and newer results from a study of children born later to exposed mothers have demonstrated developmental delays associated with maternal exposure to PCBs and CDFs (Guo et al., 1995; Chao et al., 1997).

A study of Inuit women from Hudson Bay indicated an association between levels of PCBs and dichlorodiphenylethene (DDE) in breast milk and a statistically significant reduction in male birth length (Dewailley et al. 1993a). No significant differences were

observed between male and female newborns for birth weight, head circumference, or thyroid-stimulating hormone.

A study of 338 infants of mothers occupationally exposed to PCBs during the manufacture of capacitors indicated a decrease in gestational age (6.6 days) and a reduction in birth weight (153 grams) at birth in infants of mothers directly exposed to PCBs (Taylor et al., 1984). A follow-up study of 405 women in this population demonstrated that serum total PCB levels in women with direct exposure to PCBs were more than four-fold higher than for women in indirect-exposure jobs. A decrease in birth weight and gestational age was found for the infants of these women (Taylor et al. 1989).

Immune system effects on persons exposed to PCBs have been reported in several studies. A significant negative correlation between weekly consumption of fish containing PCBs from the Baltic Sea and white cell count was reported (Svensson, 1994). Immune system effects were reported in Inuit infants who were believed to have received elevated levels of PCBs and dioxins from their mother's breast milk. Effects included a decline in the ratio of the CD4+ (helper) to CD8+ (cytotoxic) T-cells at ages 6 and 12 months (Dewailley et al. 1993). Infants examined from birth to 18 months who were exposed to PCBs/dioxins in the Netherlands exhibited lower monocyte and granulocyte counts and increases in the total number of T-cells and the number of cytotoxic T-cells (Weisglas-Kuperous et al. 1995). An increase in serum PCB levels was associated with a decrease in natural killer cells (Hagamar et al. 1995).

Effects on the thyroid have been reported in a study of the Dutch population. Higher CDD, CDF, and PCB levels in human milk correlated significantly with lower plasma levels of maternal total triiodothyronine and total thyroxine and higher plasma levels of thyroid-stimulating hormone in infants during the second and third month after birth (ATSDR, 1998).

Occupational studies show some increases in cancer mortality in workers exposed to PCBs. Significant excesses of cancer mortality were found for liver, gall bladder, and biliary tract cancer (Brown, 1987), however, co-exposure to other chemicals in the workplace limits the strength of the association to PCBs. Mortality from gastrointestinal tract cancer in males and hematologic neoplasms in females was reported for capacitor workers in Italy (Bertazzi, et al. 1987). Limitations in this study include a small number of cases, short exposure period, and lack of pattern or trend when data were analyzed by duration of exposure. The results of these studies have been evaluated and are considered inconclusive by the Agency for Toxic Substances and Disease Registry (ATSDR, 1996).

Evidence of an association between exposure to PCBs by capacitor workers and mortality from malignant melanoma was reported (Sinks et al., 1992). The workers were also exposed to various solvents. More deaths were observed than expected for malignant melanoma (8 observed versus 2 expected) and cancer of the brain and central nervous system (5 observed versus 2.8 expected). Limitations include a small

number of cases, insufficient monitoring data, unknown contribution of exposure to solvents, and possible bias due to the healthy worker effect. The results of this study have been evaluated and are considered inconclusive by ATSDR.

A recent study of male and female capacitor workers reported mortality from all cancers was significantly below expected for hourly male workers and comparable to expected for female workers (Kimbrough et al. 1999). Limitations with this study include:

- exposed and unexposed workers were included as one group diluting any potential cancer findings;
- 76 percent of the workers never had exposure to PCBs
- only 4 percent of the workers had any PCB blood data and only 2 percent worked in jobs with high exposure to PCBs; and
- 79 percent of the workers who did die of cancer had PCB exposures less than one year

ATSDR, has stated it is untenable to dismiss concerns for carcinogenicity of PCBs. In 1999, the ASTSDR convened an Expert Panel Review of the Toxicological Profile for PCBs. The panel concurred that the Kimbrough study of General Electric capacitor workers could not be used to dismiss the carcinogenic potential of PCBs (Bove, et al. 1999).

For reasons such as those above, U.S. EPA also concludes that the limitations of the Kimbrough study prevent conclusions to be drawn regarding the carcinogenicity of PCBs. While all human studies have limitations and confounders, controlled animal studies, such as a long term bioassay conducted by General Electric (Mayes, 1998) provide conclusive evidence that PCBs, including the lower chlorinated forms (i.e. Arochlor 1016 and 1242) cause cancer. For this reason, the International Agency for Research on Cancer and the U.S. Environmental Protection Agency have concluded that the PCBs are probable human carcinogens. These conclusions are independently consistent with the National Toxicology Program's eight Report on Carcinogens, which lists PCBs as "reasonably anticipated to be human carcinogens."

A recent study demonstrated a strong dose-response relationship between total lipid-corrected serum PCB concentrations and the risk of non-Hodgkin lymphoma (Rothman et al. 1997). These findings are consistent with another study where residues of PCBs in adipose tissue of non-Hodgkin's lymphoma patients were higher than those of control patients (Hardell et al. 1996). In studies of capacitor workers, significantly increased risks were reported for lymphatic/haematological malignant (LHM) diseases among female capacitor workers but non-significant increases were found for male workers (Bertazzi et al. 1987). Two other studies found no evidence of increase in LHM among workers (Brown 1987; Sinks et al. 1992).

Animal Studies

Four PCB mixtures - Aroclor 1016, 1242, 1254, and 1260 have induced liver tumors when fed to female rats. Aroclor 1260 also induced liver tumors in male rats (Mayes et al. 1998). Thyroid gland tumors were induced in male rats in the same studies. Lifetime dietary exposure to PCB mixtures with 60 percent chlorine induced liver tumors in three rat strains (Kimbrough et al. 1975; Schaeffer et al. 1984; Norback and Weltman 1985; Moore et al. 1994). The Mayes study provided strong evidence that all PCB mixtures can cause cancer. Based on animal studies, the International Agency for Research on Cancer (IARC) has concluded that PCBs are probable human carcinogens.

Other health effects observed in animals exposed to PCB include neurotoxicity, thyroid gland effects, immune system effects, and reproductive effects. Neurobehavioral effects in the offspring of monkeys have been associated with Aroclors 1248, 1242, and 1016 (Bowman et al. 1978; Levin et al. 1988; Schantz et al. 1989; and Rice, 1999). Rats exposed to PCBs exhibited thyroid gland enlargement, reduced follicular size, follicular cell hyperplasia, abnormally shaped lysosomes in the follicular cells, and decreased levels of adrenal cortex hormones which were dose-related (Byrne et al. 1987 and 1988).

Rats treated with Aroclor 1254 had reduced thymus weights and reduced natural killer cell activities (Smialowicz et al. 1989). Monkeys exposed to Aroclor 1254 had a significant decrease in IgM and IgG levels in primary response to challenge with sheep red cells (Tryphonas et al. 1989). Effects on the immune system, demonstrated in several species, form the basis of the EPA reference dose (RfD) for Aroclor 1254 (ATSDR, 1998).

Monkeys exposed in utero and through breast milk to PCBs exhibited lower birth weights, hyperpigmentation, and significantly impaired neurobehavioral test results (Schantz, 1989, 1991).

Health Studies in the Great Lakes Basin

Research indicates that the primary pathway of exposure to PCBs in the Great Lakes region is from fish consumption. Recent evidence indicates an association between PCB exposures through fish consumption and reproductive and developmental effects. Newborns of mothers in the high fish consumption category exhibited a greater number of abnormal reflexes, less mature autonomic responses and less attention to visual and auditory stimuli (Lonky et al. 1996).

The Lake Michigan Maternal Infant Cohort study was the first epidemiologic investigation to demonstrate an association between the self-reported amounts of Lake Michigan fish eaten by pregnant women and behavioral deficits in their newborns. The 242 infants born to mothers who had eaten the greatest amount of contaminated fish during pregnancy had (1) more abnormally weak reflexes; (2) greater motor immaturity and more startle responses; and (3) less responsiveness to stimulation (ATSDR, 1998). A follow-up examination of 212 children indicated that

the neurodevelopmental deficits found during infancy and early childhood still persisted at age 11 years (Jacobsen and Jacobsen, 1996).

In a study of nervous system dysfunction in adults exposed to PCBs and other persistent toxic substances, motor slowing and attention difficulties were directly related to the frequency of consumption of St. Lawrence Lakes fish (Mergler, 1997, 1998).

In an ongoing study of Native Americans in Minnesota, Wisconsin, and Michigan preliminary results indicated elevated serum PCB levels were correlated with self-reported diabetes and liver disease (Dellinger et al, 1997; Tarvis et al. 1997; Gerstenberger et al. 1997). The average annual fish consumption rate was 23 grams per day.

In a study of the PCB congener profile in the serum of humans consuming Great Lakes fish, an established cohort of persons with robust exposure to contaminants in recreationally caught Great Lakes fish were shown to have significant quantities of serum PCBs still present 15 years after enrollment in the study. The current levels of PCBs in this group were far above those found in enrollees of more recent fish-eater studies. Identification of the PCB profile in fish-eaters and non-fisheaters revealed the presence of several congeners that have the potential to affect biologic or health outcomes. Investigators are currently in the process of evaluating neuropsychologic function and thyroid function in the Lake Michigan fish-eaters for which PCB congener profiles were established (Humphrey, et al, 2000)

The Kalamazoo River Angler Survey (MDCH, 2000b) included a second phase which included a health survey and biological testing. In this second phase, individual self-reported medical information and fish consumption patterns was obtained and chemical analyses for PCBs, DDE, and mercury was performed on blood samples of 151 out of the original 938 survey participants. The study attempted to analyze for possible associations between chemical residue levels and self-reported health problems for fisheaters and compared chemical residue data from this study cohort to other fish eating populations previously studied.

The study reported that "medical problems reported as subjective symptoms (upset stomach, nausea, headache, or dizziness) were not measurable or quantifiable in an objective way. Statistically significant associations were not found between contaminant residues levels and self-reported medical problems. However, those anglers who considered themselves to be in good health appeared to be less likely to have blood PCB levels exceed median values for the aggregate group than anglers who considered themselves to be in fair/poor health."

Significantly higher levels of PCBs were found in fisheaters compared with non-fisheaters. The geometric mean for fisheaters was 2.1 ppb PCBs in blood and for non-fisheaters was 1.11 ppb PCBs in blood. Increasing residue levels for PCBs suggested a good correlation with age reflecting the persistence of these compounds in human tissues and possible higher past exposures. In contrast to previous studies of sport

anglers, the Kalamazoo River Survey appears to indicate lower exposure to PCBs. Lake Michigan open water fisheaters were first evaluated in 1979-1980 and reevaluated in 1989 (Humphrey, 1988; Hovinga et al, 1992). The Lake Michigan fisheaters consumed an annual average of 32 pounds (64 meals per year) of sport-caught fish, whereas the Kalamazoo anglers consumed an annual average of 9 pounds (18 meals per year) of sport-caught fish. The Kalamazoo fisheaters more closely resembled the nonfisheaters in the Lake Michigan study.

In a comparison of Kalamazoo anglers with a survey of anglers on Wisconsin inland lakes and rivers (Fiore, 1989), the following was observed: (1) Kalamazoo anglers ate on average less fish than the Wisconsin anglers but had higher PCB levels; (2) 59 of the Wisconsin anglers had no detectable PCBs while only 10 Kalamazoo River anglers were non-detectable; (3) the upper range of serum PCBs (73 ppb) reported in Kalamazoo was more than two and one-half times the upper range seen in Wisconsin (27.1 ppb).

Limitations of Phase II of the Kalamazoo River Angler Survey include: (1) selection bias in that the study group was self-selected; (2) fish consumption within the past 12 months was used as the exposure variable, rather than historic consumption; (3) response bias due to participants knowing the purpose of the study; and (4) biases associated with self-reporting health effects.

Appendix D
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